DOE/EA-1534

Environmental Assessment
Proposed Upgrade and Operation of the CEBAF and FEL Accelerators and Construction and Use of Buildings Associated with the 2005 Ten Year Site Plan at the Thomas Jefferson National Accelerator Facility Newport News, Virginia

(DRAFT)
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The U. S. Department of Energy (DOE), in this Environmental Assessment (EA), reports the results of an analysis of the potential environmental impacts from the proposed upgrade and operation of the Continuous Electron Beam Accelerator Facility (CEBAF) and Free-Electron Laser (FEL) accelerators and the construction and use of buildings associated with the 2005 Ten Year Site Plan at the Thomas Jefferson National Accelerator Facility (TJNAF or Jefferson Lab) in Newport News, Virginia. Jefferson Lab is operated by the Jefferson Science Associates, LLC (JSA) under contract to DOE. (The Lab was operated by the Southeastern Universities Research Association, Inc. (SURA) until June 1, 2006, when JSA assumed the Management and Operation of the Lab.) DOE has chosen to base this EA on the Ten-Year Site Plan for Fiscal Year (FY) 2007 – FY 2016 prepared in 2005 rather than the 2004 Ten Year Site Plan as denoted in the Environmental Assessment Determination (EAD) since it better reflects the Laboratory's planned and future activities.

With this proposal, DOE intends to: increase the current beam energy range of the CEBAF accelerator from a maximum energy of 8.0 GeV (Giga (billion) electron-volt) to 16.0 GeV and build expansions to the North and South Access Buildings and Service Building 98; construct a second Central Helium Liquefier (CHL) facility that would be connected to the current CHL; construct and use of a new experimental area, the Hall D complex, along with its counting house and associated service buildings; upgrade the FEL facility from the current 50 kW (kilowatt) maximum to provide 190 kW light beam power; excavate/construct two retention ponds; construct one Technical Support Building; construct a radioactive waste storage structure and several general site storage structures; expand the site utilities that serve the Accelerator Site (the fenced in area that encompasses both CEBAF and the FEL and their experimental areas) including the construction of a 10 megawatt (MW) generator pad; and the addition of a North Connector Road extension and parking lot. All of the projects and activities discussed within this EA are included in the Laboratory's 2005 Ten-Year Site Plan.

DOE proposes to take this action to provide Jefferson Lab an increased capability for accelerator and physics program operations. Since it began operation in 1995, CEBAF has enabled physics research to occur at Jefferson Lab and the use of CEBAF's continuous wave electron beam has led Jefferson Lab to play a world leadership role in hadronic physics, providing essential insights into the fundamental structure of matter. Maintaining the status quo and not performing the upgrade means that the U.S. Nuclear Physics program will lose its world leadership in the study of hadronic matter. Similar to CEBAF, if the proposed upgrade of FEL capabilities should fail to occur, the basic science community would also lose out on research opportunities involving such light sources.

In this EA, DOE presents the proposed action as summarized above, the No Action alternative, and those alternatives to this proposed action which were considered and dismissed. It also evaluates the impacts of each in Section 4.

No Action Alternative

If No Action is taken to fund any of the projects noted on this proposal, DOE would continue operating CEBAF within a beam energy range up to 8.0 GeV and the FEL at its current light

beam power maximum, and Jefferson Lab would continue to function as effectively as possible by using existing buildings and structures. Without the CEBAF and FEL upgrade**s**, the functionality of the Lab diminishes because the research reach is limited and will not be forefront. As well, for other identified projects, inefficiencies due to using nonoptimal work and storage spaces would continue.

Alternatives Considered and Dismissed

The use of another facility to perform this type of physics research was considered. There is no other CEBAF and there is no other such FEL. As well, the CEBAF and FEL accelerators can be upgraded easily and the site infrastructure is in place at Jefferson Lab. Thus, the use of alternative sites was not considered to be feasible.

For the accelerator and general facility support building actions and the drainage and transportation improvement actions, the selected Jefferson Lab sites appear to make the best use of the existing site infrastructure. These selections also limit disturbance, to the extent possible, to sites that are adjacent to existing structures or developed areas. As the most efficient and economical means to perform the functions have been studied carefully, these alternative means to accomplish the action and different sitings from those proposed were found not to be viable alternatives. Leasing offsite space to use to support operations is more expensive in the long run than operating federally owned buildings, and the proximity of staff and resources to on-site facilities would be inefficient in day to day operations.

Impacts for the Proposed Action and Alternatives

The findings of the impacts analysis of resources that could be affected by the proposed action or any of the alternatives, including No Action, are reported in this EA. Other resources or issues that are not considered in this EA, as they either do not apply to the site or there are no site issues involving them, include prime farmland, aesthetically important areas, scenic rivers, special natural resources such as aquifers, and Native American concerns. Thus, the impacts analysis in this EA, as summarized in the section entitled 'Impact Summary for the Proposed Action' below, focuses on the effects of accelerator operations, multiple construction projects, and changes in land use and building use due to additional operational requirements. This analysis looks at impacts to the environment, the workers, and the offsite public.

With No Action, the environmental effects of operating CEBAF and FEL at current levels and using existing facilities to support research would continue to be minimal, as the impacts have been over Jefferson Lab's years of operation as a research institution. Impacts for the alternatives considered would generally be more disruptive, such as more land disturbance, or more inefficient, such as greater distances to transport utilities and services, and longer times to travel to access needed supplies, than those identified for the proposed action.

Impact Summary for the Proposed Action

Environmental Impacts

Temporary Construction Impacts

As construction activities would be short-term and localized at the Jefferson Lab site, negligible to minimal impacts to the following resources are expected from this action: Geology and Soils, as almost all disturbance will be within a few feet of the surface; Floodplain, as the Jefferson Lab site is not within a 100-year floodplain; Cultural Resources, as provided by the Project Review Supervisor at the Commonwealth of Virginia Department of Historic Resources; Socioeconomics, as labor for proposed construction actions would be drawn from the local pool of tradesmen and women with only minimal additional staffing expected; and, Environmental Justice, since offsite impacts would be negligible from this proposed action.

Resources, where impacts could range from minimal to moderate, but would be limited for the duration of the construction and area stabilization, are summarized here. These impacts are fully presented in Section 4.

CEBAF, FEL, and Related Building and Equipment Operations

In general, the upgraded accelerators and their support buildings and equipment will either continue or begin to operate in the same manner as the current facility operates. As more support equipment will be needed to run the upgraded accelerators, there will be impacts due to increased resource (water and power) usage. The important potential impacts on resources as a result of CEBAF and FEL operations are discussed in Section 4.5.1 and their support facilities in 4.5.4. A brief synopsis of the potential impacts on resources follows.

Long-Term Land Use and Non-Accelerator Building Operations

The potential impacts on resources as a result of the proposed action are provided in Section 4. A brief synopsis is provided here.

There are a number of resources discussed under the Coastal Zone Management Act (CZMA) section. There are minor predicted long-term land use impacts to terrestrial resources, aquatic resources, and wetlands. Effects on storm water control, surface waters, and air quality could range from minimal to moderate. Considerations to optimize new buildings to operate in an environmentally sound manner are to be addressed during the planning stage. For long-term building and site maintenance and use, best management practices (BMPs), including environmentally sound landscaping and grounds maintenance practices, will be implemented to keep both the buildings and their support functions operating efficiently so that effects on all the above areas can be negated or minimized. These BMPs would also address resource management issues that are enforceable under this Act by taking the operational efficiencies and practical pollution prevention (P2) and waste management factors considered during the planning stage and putting them into daily practice and use. Using integrated P2 strategies will help to minimize both the use and waste of resources to the extent possible.

The following information discusses the applicable program areas reviewed.

Socioeconomics: There will be a temporary increase in on-site labor during the construction of the proposed actions. This will span over a period of 6 to 8 years. On a project by project level, labor will be drawn from the local area pool by the respective subcontractor. There is a substantial amount of construction in the local area and an adequate pool of labor is expected to be available for the proposed construction. Labor for proposed modifications and operational changes would be drawn from the pool of JSA and subcontractor staff at Jefferson Lab. Therefore, impacts to the local population, services, and economy would not be expected. With regard to environmental justice, there would be no disproportionate adverse impacts on minority and economically disadvantaged populations in the Newport News area because no important adverse impacts are expected from any aspects of the proposed action.

Cultural Resources: The Project Review Supervisor at the Commonwealth of Virginia Department of Historic Resources has advised DOE that no adverse impacts to archaeological and historic resources would be expected from the proposed action.

Geology: The site geology was thoroughly reviewed in 1995 to support the change to the groundwater monitoring permit status from a construction project to an operating facility. As excavation is limited, the proposed construction activities should not affect site geology or soils. The planned hydrogeologic study to support the placement of new monitoring wells will be used to update site geologic conditions.

Land Use: The 40-acre fenced Accelerator Site, located on the south end of the DOE property, houses the CEBAF and FEL accelerators. Proposed activities would not alter the industrial nature of the site. Approximately 13 acres of land would be impacted during the construction of all projects, both on and off the Accelerator Site, and approximately 3 to 4 acres of this land would remain impervious as roads and facilities for the life of the facility. Both temporary and long-term impacts to soils due to the project would be minor. Impacts would include soil loss through erosion, compaction, and loss of structure in soils that are disturbed or driven on during construction.

Transportation and Traffic: Although the topics Traffic and Transportation do not apply under the CZMA, they were also reviewed for impacts. Additional public and site roads will have increased use during the construction activities. Through optimizing parking and transportation layouts during the planning process, any additional site traffic considerations will not impact the environment more than at present. Thus, no significant impacts are expected.

Noise: Local construction noise would exceed ambient noise levels and may be heard for some distance within the project area. Normal building and equipment functioning produces noise as is typical on the Jefferson Lab site. Given the urban

nature of the site and its vicinity, noise from operations would not be unique. While noise from operating equipment and traffic would regularly be perceptible in nearby areas, no adverse effects on human hearing would occur. Noise stemming from operating equipment such as compressors will be limited to interior building areas and is addressed as a worker health and safety issue, below.

Floodplain/Wetlands: The DOE site is not within a 100-year floodplain, so no such floodplain areas will be affected by this action. From previous studies and reviews by the U.S. Army Corps of Engineers, the only identified wetland area onsite will not be disturbed by this action, so there will be no impact on any potential wetland area.

Endangered Species: In accordance with Endangered Species Act requirements, DOE informally consulted with the U.S. Fish and Wildlife Service and the Commonwealth of Virginia Department of Game and Inland Fisheries, Department of Agriculture and Consumer Services, and Bureau of Plant Protection for comment on the proposed actions. No adverse impacts to protected species and/or habitat would be expected from the proposed action.

Spill Potential: The requirements for implementing spill prevention and control practices would be incorporated into applicable subcontract specifications. For day to day operations, Jefferson Lab applies both engineering and administrative controls to reduce the potential of a spill or release. These programs and procedures will be adapted to cover any new potential spill sources.

Groundwater Dewatering: Temporary construction dewatering at excavations will likely be necessary, but as this type of activity will be short term, only minimal impacts from this activity will occur, and controls incorporated into applicable subcontract specifications. Completion of this action will not have an impact on the flow quantity at the groundwater dewatering operation at the experimental halls. No impacts from radiation are expected, as discussed in the Radiological Impacts section titled Groundwater below.

Water Quality: The only expected impacts on water quality due to accelerator operations will be radiological, so there should be no non-radiological impacts on local surface or ground water, including from the dewatering effluent.

Surface Water – Impacts not Involving Radiation

Erosion and sedimentation to on-site storm water channels and storm drainage systems, including at local roadways, could result from land disturbances during on-site construction activities and would be controlled by implementing standard erosion control measures, as specified in construction subcontracts, until stabilization is complete.

Further development on the DOE site could result in minimal to moderate offsite impacts to surface water if changes in storm water flows are not mitigated. The retention ponds being added under this action will incorporate recommended

measures that would offset impacts due to this action and other potential facility growth, and should negate or minimize any offsite impacts.

Impacts from radiation from this action are not expected, as discussed in the Radiological Impacts section titled Surface Water below.

Radiological Impacts – All Waters That Could Be Affected by Radiation

Generally, radiological effects on groundwater and surface water from upgraded CEBAF operations, including at the three existing experimental halls, Hall A, Hall B, and Hall C, and at the new Hall D, will continue to have the potential for minor impacts to ground and surface waters. Impacts to ground and surface water from upgraded FEL operations will be negligible. The effects on surface waters include negligible impacts from the controlled discharges of activated waters to the local sanitary sewer system. Any impacts will be mitigated as presented in Section 4.4.2.2 and are briefly described below.

Groundwater

As operational levels will change, appropriate shielding will be installed, including at both Halls A and C at their high power beam dumps (HPBDs), to reduce the probability of impacting groundwater. Negligible impacts on soils or groundwater in the vicinity of the accelerator or near any of the halls from prompt radiation are expected.

Process Water

The generation of radioactive wastewater from various sources is expected to slightly increase with CEBAF accelerator operation under the proposed parameters. This water will be managed under the current program using the controlled discharge of small quantities to the public sewer system, and ultimately to surface waters, in accordance with the Lab's Hampton Roads Sanitation District (HRSD) permit.

Because these increased levels of activity can be managed under the current site program, no additional impacts for addressing this activated process water are projected for operation under the proposed parameters. Materials that would be collected for discharge that are outside of permit criteria would be disposed under controlled conditions as low level activated waste, a minimal, not expected, impact.

Surface Water, Including That to the Sanitary Sewer System

The only potential radiological impacts to the surface water are from accelerator sump pumps located throughout the accelerator complex, from the groundwater dewatering activity at the halls described in Section 4.4.4.3.1, and from the indirect discharges of activated water to the sanitary sewer mentioned above. The water from the accelerator area sumps is collected, and if it does not meet standard surface release requirements, is disposed offsite as activated water. Discharges from any new facilities would be managed under current site

programs. As all releases to the surface are managed under current programs, there would be only minimal additional impacts to surface water from the possible increased quantities of activated water, as defined in permit limits, released to the sanitary sewer.

Air Quality: The operation of construction equipment and vehicles onsite would produce air emissions common to construction sites and localized near the site of operation. Contribution from the proposed action to offsite concentrations of regulated non-radiological air pollutants, such as dust particulates, would be minimal.

The operation of CEBAF above 8.0 GeV will result in minimal effects on the air quality within the CEBAF accelerator tunnel or experimental halls and negligible effects at the new Hall D complex. This will also apply outside the Accelerator Site and at the site boundary. Programs required under the National Emission Standards for Hazardous Air Pollutants (NESHAPs) in the Code of Federal Regulations (CFR) Subpart H of 40 CFR 61 will be administered to meet regulatory and DOE requirements.

The operation of the upgraded FEL will result in no additional radiological effects within the FEL tunnel or at the site boundary.

Under this proposed action to upgrade the two accelerators, the radiological impacts will be minimal but will continue to be managed as done under current site programs to remain As Low As Reasonably Achievable (ALARA).

Waste Generation: There will be a temporary increase in waste generation due to construction activities, however, subcontractors would be encouraged to minimize waste generation through subcontract specifications. During operations, building and accelerator, only minor increases in the quantities of sanitary and radioactive wastes generated from this proposed action are expected. The Lab encourages recycling in all site activities. All waste and recyclable materials management issues are addressed in current programs as well as in the Jefferson Lab Environment, Health & Safety (EH&S) Manual.

Pollution Prevention: General P2 considerations, that include waste minimization, energy efficiency, and environmentally preferable purchasing (EPP), will be taken into account during the design and construction of the proposed buildings. Building and accelerator operations will incorporate P2 considerations into the design and operations to the extent possible.

Resource Usage: Generally, the increase in the demand for power and water to support upgraded accelerator operations will have the potential for moderate impacts to local utility resources. All will be mitigated and/or further researched as described in detail in Section 4.4.10. The need for additional supplies of power and water and cryogens for cooling will be substantial but is well supported by offsite systems, and the increased resource demand will be mitigated by further exploring and using

alternative sources, such as treated wastewater and state of the art equipment that should reduce loading factors.

Health and Safety Impacts

The expected level of impact regarding safety and health concerns for each of the identified activities has been evaluated for this proposed action.

Construction Hazards: The hazards of note during construction will be typical for this type of activity, such as working on elevated areas and electrical safety. There will be no more impact than that at any typical construction project.

Radiological Impacts: Most of the occupational radiation exposure at Jefferson Lab would continue to occur during maintenance activities on activated components. The level of induced radioactivity in the components is directly proportional to the amount of electron beam power lost in the components. CEBAF operation at energies up to 16.0 GeV would result in potential beam power loss to the same maximum level as current up to 8.0 GeV operations (i.e., 1 MW in either Hall A or Hall C). Consequently, changes in beam energy, as proposed, are not expected to increase occupational radiation exposure.

The chief source of radiation exposure for members of the general public is "skyshine" radiation. An analysis of skyshine production mechanisms for electron beam energy of 16.0 GeV has shown that the increased number of neutrons directed toward the roof from beam loss at the target region will be offset by the reduction of beam loss from the target region to the HPBD areas in each experiment hall. As a result the general public exposure should remain constant for an increase in energy from 8.0 GeV to 16.0 GeV.

The public may be exposed to small quantities of radioactivity induced in air in the CEBAF enclosure as a result of nominal ventilation during routine operations. The production of ozone, oxides of nitrogen, and radioactive gases by CEBAF operation, including in the experiment halls, the primary gas generation areas, has been shown to be directly proportional to the amount of beam power loss. Because beam power loss in the experiment halls is expected to remain similar to that occurring at current operating energies, the amount of ozone, nitrogen oxides, and radioactive gases will remain at approximately the same level under the proposed action.

The safety and health impacts to workers and the public due to radiological activity resulting from Hall D operation are very low, as this is a low hazard machine and will involve using the same type of controls and support equipment that is currently in use at Jefferson Lab.

Noise: Noise impacts on those working in new high noise work areas will be the same as those in current areas. Health and safety mitigation measures are found in current Lab programs and procedures.

Non-Radiological Impacts: Non-radiological hazards associated with the proposed action include electrical, chemical, and non-ionizing radiation (lasers), which could injure and, in extreme cases, can be potentially fatal to occupational workers. Engineering controls, as well as administrative procedures specified in the Jefferson Lab EH&S Manual, are used by the Lab to minimize the potential for accidents involving electricity, chemicals and lasers. Special controls will be used to reduce the chances of the FEL's outdoor laser light beam from making contact with flying objects or any people working at that height.

Cumulative Impacts

Cumulative environment, health, and safety impacts are those which result from the incremental contribution from each effect discussed above along with impacts expected from other past, ongoing, or planned actions within the same geographic area.

Both on and offsite major construction activities will have temporary and long term site related impacts. On-site construction actions would be managed to keep impacts to a minimum, but DOE has no control over offsite activities.

CEBAF and the FEL will be operated within their proposed or specified operating limits and within identified site limits to minimize cumulative impacts to the environment, occupational health factors, and public health and safety concerns. The minimal to moderate radiation-related impacts related to CEBAF operations and the minimal impacts related to FEL operations will be long term, but will also be managed to minimize any impacts as reported in this EA. The radiological impact of the action proposed in this EA will be offset by factors such as radioactive decay and engineering and administrative controls. Radioactivity levels will remain substantially below permit limits and, therefore, any changes that are not inconsequential will be anticipated and mitigated so that effects on the environmental and public health conditions are not affected beyond those under current operations. There will be no cumulative impacts involving radioactivity from the combination of operating the upgraded CEBAF and FEL accelerators simultaneously. CEBAF and the FEL will be operated within their proposed or specified operating limits and within identified site limits to minimize cumulative impacts to the environment, occupational health factors, and public health and safety concerns.

As for non-radiological environment, health, and safety related operational impacts, the routine operation and use of the new experimental hall, the upgraded accelerators and existing experimental halls, and the other new DOE facilities would be managed to keep impacts to a minimum, as is done to the extent possible for existing accelerator and site building operation.

It is anticipated that any development on the adjacent SURA and City properties would also be managed to keep impacts to a minimum and to result in no impact to the DOE site. The long-term effects from the impervious cover on-site have already been analyzed and BMPs have been identified to minimize on-site effects and to not affect offsite properties.

Thus, there would be cumulative impacts when taking into account the construction, operation, and use of the new buildings and the operation of the upgraded CEBAF and FEL accelerators

when combined with the other impacts from beyond the site boundaries, though none of these activities would have major impacts on occupational and public health and safety.

1.0 INTRODUCTION

1.1 PREVIOUS ACTIONS

In this EA, the DOE reports the results of an analysis of the potential environmental impacts from proposed upgrades and operation of the CEBAF and FEL accelerators as well as construction and use of buildings associated with TJNAF's 2005 Ten-Year Site Plan.[1]

On January 12, 1987, DOE issued a finding of no significant impact (FONSI) based on an EA of the proposed construction and operation of CEBAF (DOE/EA-0257). Construction was completed in early 1995. Commissioning of components paralleled construction activities so that the accelerator began operating to serve the DOE physics program in late 1995. It has continued operating to this day.

In the 1987 EA, the proposed action for which impacts were evaluated was the operation of CEBAF to produce an electron beam energy in the range from 0.5 to 4.0 GeV with a maximum beam power of 1000 kW (1 MW). CEBAF produces an electron beam for experiments in basic nuclear physics, in particular, for the study of quark structures and behaviors and the forces that govern the clustering of nucleons in the atomic nucleus.

In 1997, in accordance with the DOE National Environmental Policy Act (NEPA) regulation, a new EA (DOE/EA-1204) was completed to review the environmental, health, and safety impacts of changing the range of operating parameters of the CEBAF and constructing and operating the FEL within certain operating parameters. On November 5, 1997, DOE issued a FONSI based on the 1997 EA. DOE found that the proposed action did not have the potential for causing significant impacts, as was also concluded in the 1987 FONSI. Thus, DOE concluded that no further NEPA review was necessary for either the change in operating parameters of CEBAF, including increasing the energy range up to 8.0 GeV at a maximum beam power of 1000 kW, or for the operation of the FEL with 10 kW UV (ultraviolet) or 20 kW IR (infrared) laser beams for experimental use.

In a third EA (DOE/EA-1384), impacts were evaluated for the construction of various site improvements and the proposed installation and operation of the High-Energy Lithography Source (Helios) accelerator in the FEL addition. It was determined that the proposed improvements at Jefferson Lab did not constitute a major Federal action that would significantly affect the quality of the human environment within the context of NEPA, and a FONSI was issued on July 13, 2002.

1.2 SCOPE OF THIS PROPOSED ACTION

The proposed action evaluated in this EA involves addressing further changes in the operating parameters of the CEBAF and FEL accelerators. With this proposal, DOE intends to increase the maximum beam energy of CEBAF from 8.0 GeV to 16.0 GeV and increase the beam power from 1 MW to a maximum of 2 MW in the recirculating linear accelerator (linac) section of CEBAF, with a maximum beam power of 1 MW at both HPBDs simultaneously. DOE intends to increase the FEL accelerator beam power from 1.6 MW to 22 MW and the IR laser beam

[1] TJNAF 2005. Ten - Year Site Plan FY 2007 – FY 2016.

power of 50 kW (operations) to a range of 100 kW to 190 kW and the UV beam from 2 kW to 20 kW.

The proposed action also involves expansion of the CHL and three existing service buildings to support the CEBAF upgrade; addition of a fourth experimental hall (Hall D) with its counting house and associated service buildings; excavation/construction of two retention ponds and their associated storm water channels; construction of a Technical Support Building; construction of a radioactive waste storage structure and several general site storage structures; expansion of Accelerator Site utilities including the construction of a 10 MW generator and pad; and, construction of the North Connector Road extension and parking lot. The majority of these actions takes place on the Accelerator Site (a fenced radiological area) that contains both the CEBAF and FEL accelerators, and the CEBAF experiment halls and support buildings. The remainder of the Jefferson Lab site is denoted as "the campus".

DOE has prepared this EA to determine the potential for adverse impacts from increased radiation produced with the upgraded operation of CEBAF and FEL and from increased resource use, disturbance of land from construction, effects on the offsite population, and other sources of potential impact.

1.3 PURPOSE AND NEED FOR ACTION

The Jefferson Lab facilities were originally built to support the 4.0 GeV program and allowed marginal user and limited technical support space with no planned future growth.

The facilities were expanded slightly to support the now 8.0 GeV program, but the site still provides limited technical support work areas even though there has been continual growth of our physics program. The proposed actions under this EA facilitate existing operations in addition to addressing the planned upgrades of CEBAF and FEL.

The proposed accelerator upgrades will enable Jefferson Lab to expand its research capabilities. Experiments that may be conducted at beam energies above the current 8.0 GeV limit, using a continuous electron beam accelerator, would take decades to complete at other U.S. electron beam facilities, because they operate with a pulsed beam, which generates data at a rate 1000 times slower than the continuous beam option of CEBAF. The upgraded CEBAF is critical to obtaining insights into the hadronic and quark/gluon description of matter. These scientific opportunities have been identified as one of the highest priorities by the Nuclear Science Advisory Committee (NSAC) and have also been endorsed by the National Academy of Sciences. The addition of Experimental Hall D will allow CEBAF to map the spectrum of gluonic excitations starting with exotic hybrids.

The FEL upgrade is necessary for: industrial applications; studies by our Laser Processing Consortium (LPC) partners for high volume processes such as surface modification of metals and polymers; improving the capability to perform fundamental medical measurements and material property studies; and, as well, partnering with the Navy to further tune IR FEL radiation to the windows in the atmospheric spectrum where there is minimal absorption.

The purpose of the proposed action is to continually improve Jefferson Lab's capability to expand its research capabilities.

2.0 PROPOSED ACTION AND ALTERNATIVES

2.1 BACKGROUND

The NEPA of 1969 and the Council on Environmental Quality (CEQ) regulations implementing NEPA require that the environmental impacts of any proposed federal action be evaluated and considered in comparison to the impacts of various alternative actions. Alternatives available to DOE include (1) No Action, (2) construction and operation of these actions at other locations at Jefferson Lab, and (3) construction and operation of these actions at a location other than Jefferson Lab.

The proposed action evaluated herein will require additional DOE funding for upgrading the accelerators and for construction of buildings, including those associated with the CEBAF upgrade, and the construction of retention ponds and roads.[1]

The following sections present a description of the proposed action and alternatives and a comparison of the impacts of each. Note that the proposed action incorporates all related activities identified when this proposal was initiated.

2.2 DESCRIPTION OF THE PROPOSED ACTION

The proposed action in this EA (DOE/EA-1534) involves increasing the beam energy range of the CEBAF accelerator from the current maximum energy of 8.0 GeV at 1 MW to 16.0 GeV and increasing the beam power at CEBAF to 2 MW; expanding the North and South Access Buildings (#38 and #67) and Service Building (#98); and, upgrading the FEL to provide 190 kW light beam power. Also covered are the construction of a second CHL facility that would be connected to the current CHL; the construction and use of a new experimental area, the Hall D complex; excavation/construction of two retention ponds and associated surface water channels; construction of Technical Support Building #2 (TSB2); construction of a radioactive waste storage structure and several general site storage structures; expansion of Accelerator Site utilities including the construction of a 10 MW generator and pad; and, constructing the North Connector Road extension and parking lot.[1] A vicinity plan of Jefferson Lab is provided as Figure 1. Figure 2 is a site map and includes the projects proposed in this EA. An aerial photograph of the site is provided as Figure 3. Figure 4 provides a rendering of the new Hall D experimental area.

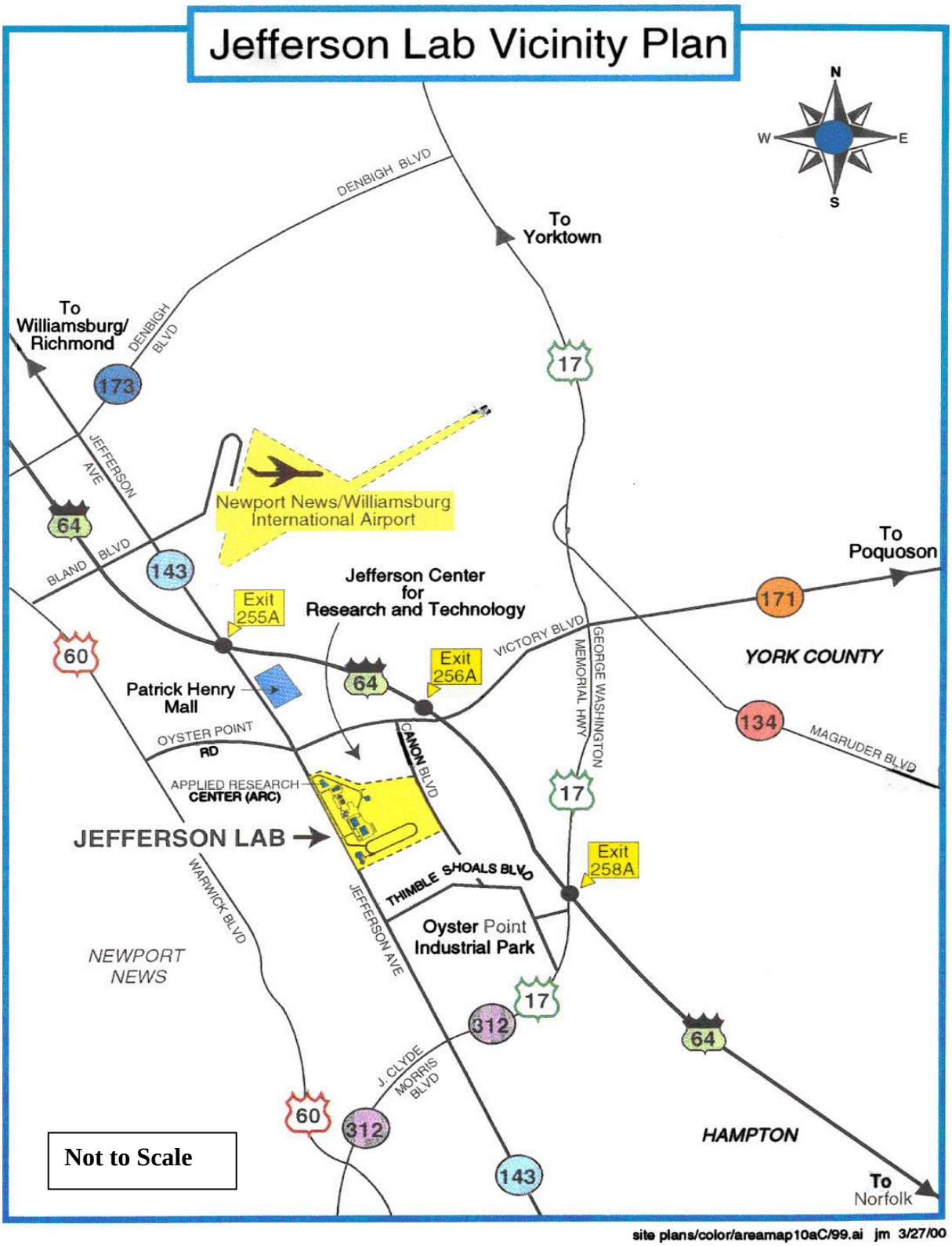

Figure 1 - Jefferson Lab Vicinity Plan

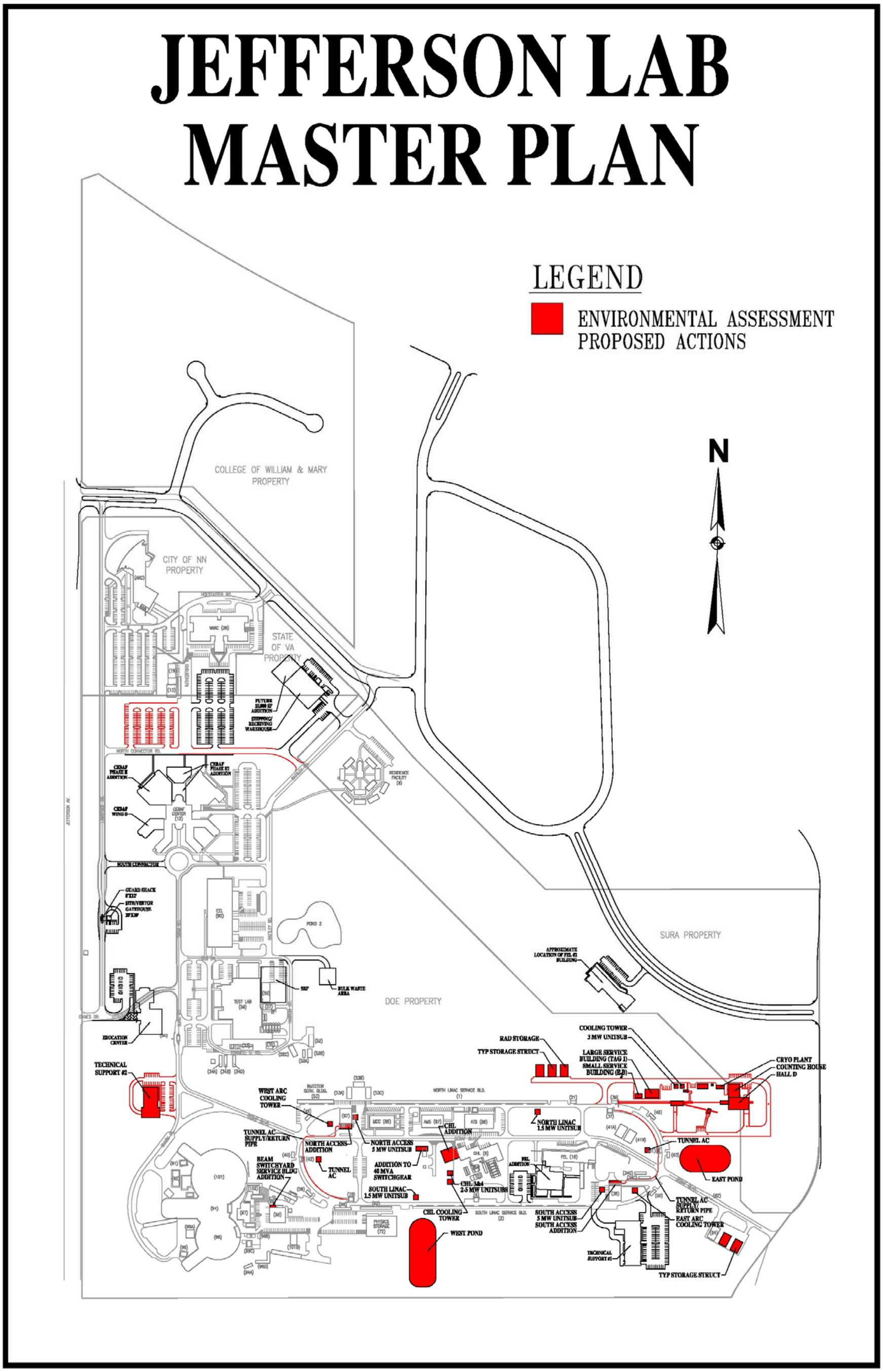

Figure 2 - Jefferson Lab 10-Year Master Plan with EA-1534 Projects Indicated
(Not to Scale)

Figure 3 - Site Aerial Photo (1998)
(Not to Scale)

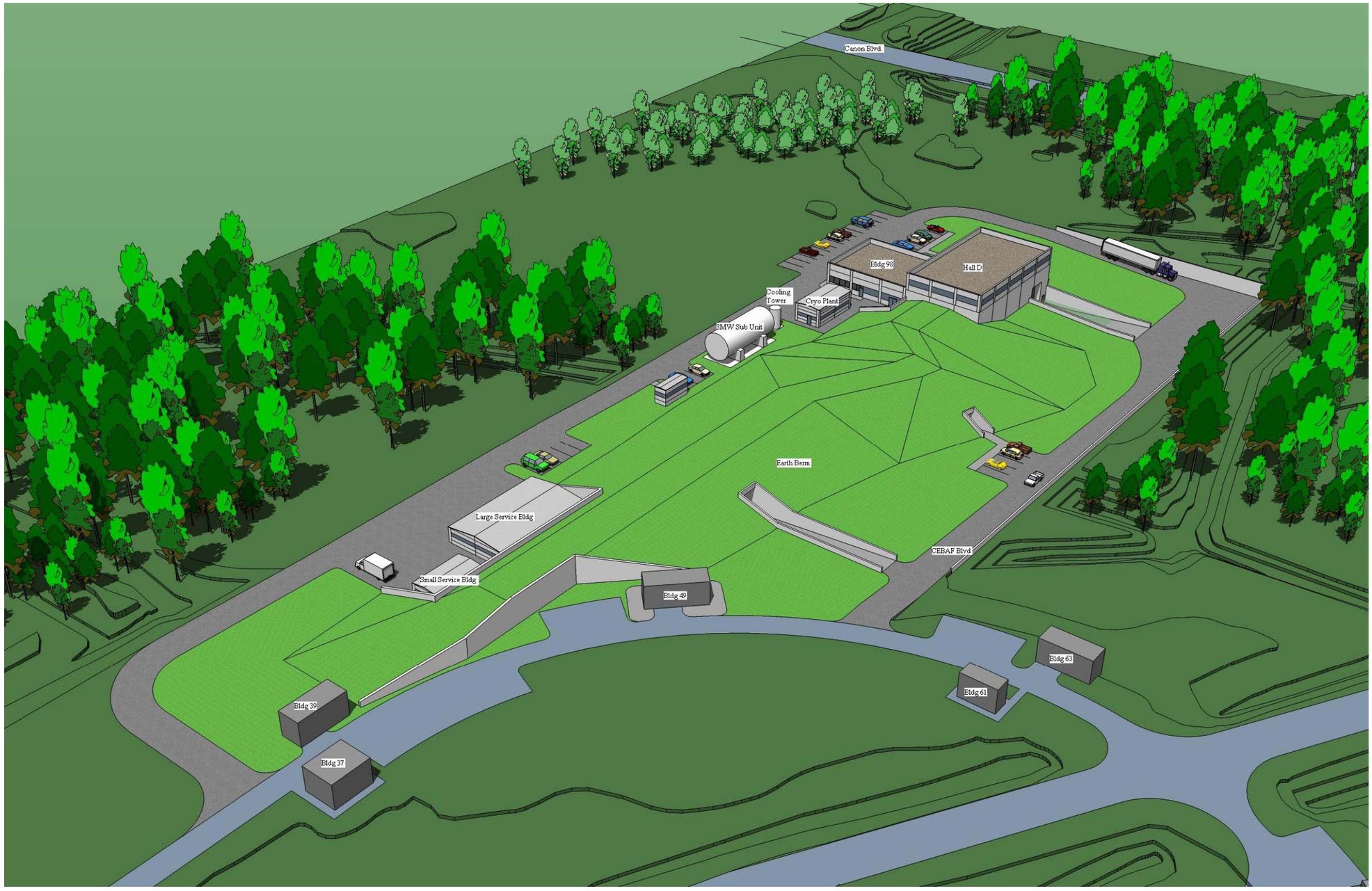

Figure 4 - Rendering – West View of Proposed Hall D Complex

2.2.1 Accelerator Upgrades and Related Actions

2.2.1.1 CEBAF and Experiment Area Upgrade and the Hall D Complex

The proposed action involves a change in the operating parameters of CEBAF that would require modifications to the accelerator housed in the underground enclosure, its support equipment contained in multiple above ground service buildings, and the Accelerator Site utility systems. The upgrade will enable Jefferson Lab to make important qualitative changes to its physics research capability at both the new Hall D and at the existing experimental area (Halls A, B, and C).

The Hall D complex will consist of an experimental hall, a counting house, beam dumps, cryogenics plant, and service buildings. The scientific goal of Hall D is to map the spectrum of gluonic excitations starting with exotic hybrid mesons. This upgrade will allow experimenters (users) to cross the threshold above which the origins of quark confinement can be investigated.

The continuous wave (CW) nature of the upgraded CEBAF beams will afford experimenters the opportunity to cleanly assess hadron structure throughout the entire "Valence Quark Region" and exploit newly discovered Generalized Parton Distributions. The upgrade will also allow direct exploration of the quark-gluon structure of hadrons and nuclei.

The upgrade to the 16.0 GeV range will allow Halls A and C to perform precise determinations of valence quark properties in nucleons and nuclei and to study short range correlations, form factors, and hypernuclear physics.

Hall B operations will be enhanced with new instrumentation (CLAS 12) which will be used to gain a new understanding of nucleon structure via measurements of generalized parton distribution.

The proposed changes in the maximum effective operating parameters of the CEBAF are presented in Table 1.

Table 1- CEBAF Maximum Effective Operating Parameters

Parameter	Present Operating Level	Proposed Operating Level at CEBAF	Proposed Operating Level at Halls A and C	Proposed Operating Level at Hall B	Proposed Operating Level at Hall D
Beam power	1000 kW (1 MW)	2000 kW (2 MW)	1 MW	27.5 kW	80 kW
Beam energy	8.0 GeV	16 GeV	16 GeV	16 GeV	16 GeV

2.2.1.1.1 No Action

Maintaining the status quo and not performing the upgrade means that the U.S. Nuclear Physics program will lose its world leadership in the study of hadronic matter. Significant investment has been made in the present facility that has already taken into account plans to incorporate a cost-effective upgrade into our current machine that would

provide scientific forefront capabilities and maintain this scientific leadership for the next decade and beyond. Not taking this opportunity would mean preventing the physics community from taking advantage of this scientifically productive machine. Not constructing the Hall D complex would result in the scientifically costly loss of one of the two major physics programs related to the Jefferson Lab upgrade, identified by the DOE Science Review in April 2005 as having discovery potential.

2.2.1.2 Alternatives Dismissed from Consideration

2.2.1.2.1 Construction and Operation of this Action at Another Location at Jefferson Lab

The proposed CEBAF upgrade utilizes the existing tunnel and does not change the existing basic layout of the accelerator. The planning for the CEBAF upgrade has optimized the equipment and buildings that would best serve the Lab and the taxpayers. The upgrade of the entire machine at a different location would require the duplication of many existing facilities to support this action and an increased environmental impact. This option would cost a considerable amount over and above what it would cost to upgrade CEBAF at its present location. The minimum required energy of 12.0 GeV can be achieved most economically by using the existing accelerator and by placing Hall D at the proposed location. Any other locations at Jefferson Lab would impact the technical capabilities of Hall D.

2.2.1.2.2 Construction and Operation of this Action at a Location Other than Jefferson Lab

Neither the DOE, nor the world, has an existing research accelerator that could be as easily modified to perform at the operating levels proposed by this action. CEBAF is the only high-average-current (200 microampere) continuous electron beam accelerator that can be used for conducting experiments in the 8.0 to 16.0 GeV range. It has the unique capability of providing a continuous beam as well as a pulsed beam. This feature enables it to better support nuclear physics studies because data is generated over a thousand times faster than at other pulsed-beamed accelerators. Therefore, the use of an accelerator at another DOE site for the research to be conducted at a beam energy of up to 16.0 GeV is not a reasonable alternative.

2.2.2 FEL Upgrade

The proposed action involves a change in the operating parameters of the FEL that would require modification to the accelerator and its support system. The upgrade will enable Jefferson Lab to make important qualitative changes to expand the capability of photonics research.

The CW nature of the upgraded FEL beams will permit, for the first time, propagation tests of any FEL to determine atmospheric response at significant power absorption within the desired wavelength bands while maintaining the short pulses characteristic of typical FEL output.

2.2.2.1 No Action

Maintaining the status quo and not performing the upgrade means that the U.S. Navy Directed Energy effort will be unable to determine the viability of free-electron lasers as defensive systems. Significant investment has been made in the present facility to develop this capability

at Jefferson Lab to bring this system to its forefront capabilities and provide photons for applied and basic research to establish a foundation on which to build this new capability.

2.2.2.2 Alternatives Dismissed from Consideration

2.2.2.2.1 Construction and Operation of this Action at Another Location at Jefferson Lab

The FEL is already constructed and can not be duplicated at another location at Jefferson Lab without considerable amounts of money over and above what it would cost to upgrade the FEL at its present location. Both the existing building and much of its support infrastructure have been designed to accommodate this power increase.

2.2.2.2.2 Construction and Operation of this Action at a Location Other than Jefferson Lab

Neither DOE nor the world has another existing research accelerator that could be modified to perform at the operating levels proposed by this action. The Jefferson Lab IR/UV upgrade FEL is the only high-average-current (10 milliampere) continuous electron beam accelerator that can be used for conducting experiments in the near infrared (IR), visible or ultraviolet. It has the unique capability of providing a continuous beam train as well as a pulsed beam, and it uses energy recovery. This energy recovery feature enables the FEL to operate continuously at high beam powers at high beam production efficiency with low radiation production. Therefore, the use of an accelerator at another DOE site for the high average power FEL research to be conducted is not a feasible alternative.

2.2.3 Construction of a Second Central Helium Liquefier (CHL #2)

Upgrading CEBAF will increase the heat load on the cryogenic system. The proposed action is to double the cryogenics capacity to meet the increased heat load. The existing CHL Building will be expanded by approximately 4,800 square feet (SF) to house the additional refrigeration equipment for CHL #2, and additional exterior gas storage vessels will be installed.

2.2.3.1 No Action

No Action would eliminate the capability of the CEBAF upgrade. As stated above, the U.S. Nuclear Physics program would lose its world leadership in the study of hadronic matter.

2.2.3.2 Alternatives Dismissed for Consideration

2.2.3.2.1 Construction and Operation of this Action at Another Location at Jefferson Lab

Other locations for CHL #2 would require duplication of existing facilities and increase the distribution distance to the point of use and increase the disturbed land.

2.2.3.2.2 Construction and Operation of this Action at a Location Other than Jefferson Lab

The CHL expansion is to support the CEBAF GeV upgrade and if this facility was in another location, it would not be able to serve the Jefferson Lab physics program.

2.2.4 Accelerator Site Utility Upgrade

Standard Utility System Modifications and the Related Building Modifications: Standard utilities, power, communication, and water systems will need to be upgraded to support the new operating levels of CEBAF and the FEL. As well as covering the accelerator upgrades, these described utility system expansions include the additional resources needed to support the new CHL #2 and the Hall D complex.

2.2.4.1 Accelerator Equipment Cooling: Low Conductivity Water (LCW) and Industrial Cooling Water (ICW)

The capacity of the three CEBAF/FEL ICW cooling systems at Buildings 8 (CHL #1), 38, and 67, including the associated cooling towers and pumping systems, will be expanded. The construction for these units will disturb a total of about 5,000 SF of grassed and/or paved area. Fresh water use will be increased to meet the higher cooling needs resulting from the new operating levels at the accelerators.

The LCW supply and distribution system at Buildings 38 and 67 will provide cooling for five additional radio frequency (RF) zones at the North and South Linacs and at the Arc 10 magnets to support the upgraded CEBAF operations, as well as the new Hall D transport line. Additions of 1,800 SF each to Buildings 38 and 67 (disturbing about 2,500 SF of asphalt paved area) will house the new LCW equipment.

2.2.4.2 CEBAF Tunnel Air Conditioning

The air conditioning of the CEBAF arc tunnel environments will have to be enhanced to handle the upgraded accelerator-generated heat loads. The present air conditioning system will be optimized to handle the increased heat load and maintain acceptable conditions by augmenting it to provide more cooling capability, possibly through the use of a natural convection system. The construction will disturb a total of about 2,000 SF of grassed area adjacent to the current equipment next to the CEBAF service buildings.

2.2.4.3 Electrical

The accelerator area power grid is proposed to be expanded by adding seven new unit substations and connecting them to the existing system via duct banks. In addition to this effort, a 10 MW generator pad, approximately 100 feet (ft.) x 100 ft., will be constructed in a grassed and wooded area west of the existing 40 MW substation to maintain liquid helium during extended power outages. As well, about 5,000 SF of land in the vicinity of existing service Buildings 38, 67, 8, and 18 will be disturbed. A 300 SF addition to Building 98 will house additional power supplies and disturb about 900 SF of paved area. The existing 40 megavolt ampere (MVA) primary substation's switchgear will require an expansion to accommodate the new substations for CHL #2.

2.2.4.4 No Action

If the utility system expansions noted in Section 2.2.4 do not occur, the No Action would eliminate the capability of the CEBAF upgrade, including the production of the correct type of beam to do research at Hall D. CEBAF, the FEL, and their support equipment positioned around the Accelerator Site would continue operating using the current utility network.

2.2.4.5 Alternatives Dismissed from Consideration

2.2.4.5.1 Construction and Operation of this Action at Another Location at Jefferson Lab

If other Jefferson Lab locations for the utility upgrades were to be utilized, it would increase the distribution distance to the point of use. As such, there would be transfer inefficiencies that would adversely affect operations.

2.2.4.5.2 Construction and Operation of this Action at a Location Other than Jefferson Lab

Since these utility upgrades are in support of CEBAF and the FEL, it would not be feasible for them to be constructed and used at other locations away from the Jefferson Lab site.

2.2.5 East and West Retention Ponds and Associated Surface Water Channels

Jefferson Lab completed a site wide storm water management study in 2003 that was updated in 2004. The Accelerator Site area is split between two watershed areas. The ponds and associated storm water channels are proposed to manage the increased storm water runoff from planned construction.[1] The East Retention Pond will be located east of Building 63 in Watershed Area 1 and will disturb about five acres of grassed and wooded areas. The West Retention Pond will be located east of Building 72 in Watershed Area 2. The west pond will disturb approximately 1.5 acres of grassed and wooded areas.

2.2.5.1 No Action

Section 402 of the Clean Water Act established the National Pollutant Discharge Elimination System to limit pollutant discharges into streams, rivers, and bays. In the Commonwealth of Virginia, both the Department of Environmental Quality (DEQ) and the Department of Conservation and Recreation (DCR) administer the program as the Virginia Pollutant Discharge Elimination System (VPDES). DEQ and the DCR coordinate separate Commonwealth programs that regulate the management of pollutants carried by storm water runoff. DEQ regulates storm water discharges associated with "industrial activities", while DCR regulates storm water discharges from construction sites and from municipal separate storm sewer systems (MS4s). The proposed action is in accordance with Jefferson Lab's VPDES MS4 permit. Action is required to support the new development.[1]

If No Action were taken, the Lab would not be able to manage the increased storm water runoff leaving the site with future developments. These ponds address the new development document.[1]

2.2.5.2 Alternatives Dismissed from Consideration

2.2.5.2.1 Construction and Operation of this Action at Another Location at Jefferson Lab

Jefferson Lab's site wide storm water management study identified the proposed locations as the optimal sites to manage the increased storm water runoff due to increased impervious surfaces from new developments.[1] Therefore, siting the ponds in different locations on-site, while remaining within the same drainage area, would not have the benefit of serving the drainage area affected most by this disturbance.

2.2.5.2.2 Construction and Operation of this Action at a Location Other than Jefferson Lab

Since the new developments are going to be performed at Jefferson Lab, siting retention ponds at a location other than Jefferson Lab was not considered.

2.2.6 Technical Support Building 2

This project will provide for the construction of a new two-story, 16,000 SF technical support facility for operations on the Accelerator Site. The proposed site is at the northwest corner of the Accelerator Site and will take up about half of an existing bulk lay-down area. The facility will provide technical spaces, offices, and a high bay area for equipment assembly. This project will disturb about 1 to 1.5 acres of land, which includes parking for building occupants and a drive-through access to the high bay space. Utilities will be extended from adjacent utility distribution systems, so only a minor utility upgrade for this project is needed. The majority of the construction area is a gravel yard that is in use as an equipment storage area. A small amount of tree clearing may be necessary at the site perimeter, which will be determined as the facility layout is finalized. Storm channels in the vicinity may need to be modified or rerouted.

The presently stored materials and equipment will be relocated to other existing storage locations or inside the planned storage buildings described in 2.2.8, so no other area is to be disturbed for that action.

2.2.6.1 No Action

This project is to support current operations. Current staff and users are working out of aging trailers and out of accelerator service buildings not designed for occupants. As well, many of the involved groups are not collocated or are not located near their technical work area. Jefferson Lab has a large backlog of user experiments consisting of increasingly more complex setups, some taking up to six months to stage. No Action will continue use of sub-standard work spaces and operational inefficiencies.

2.2.6.2 Alternatives Dismissed from Consideration

2.2.6.2.1 Construction and Operation of this Action at Another Location at Jefferson Lab

As part of the Ten Year Site Plan development, Jefferson Lab identified the need for two Technical Support Buildings to meet current technical, office, and experimental setup space. The two buildings are to be located at opposite ends of the Accelerator Site at concentrated work centers to maximize flexibility and minimize impact to non-developed land. The need and location for Technical Support Building #1 was identified in the 2002 EA.

2.2.6.2.2 Construction and Operation of this Action at a Location Other than Jefferson Lab

This project is to support current operations and to provide for a work area near the accelerator complex. Having it at a location other than Jefferson Lab will not improve interaction inefficiencies.

2.2.7 Low-Level Radioactive Waste Handling Storage Building

This project is for a low-level radioactive waste (RAD) storage building consisting of approximately 2,400 SF. The RAD storage space will provide an enclosed space to meet both existing and future needs as a staging area until the waste can be disposed of offsite. A new limited access gravel road will be constructed from an existing paved roadway to serve the new building and the structures described in 2.2.8. A continuous apron along the front of the building will facilitate loading and unloading activities. The building will be placed on a concrete pad, with the perimeter pitched to allow water to drain away from the building. As utility service for this building is minimal, required utilities will be extended from an adjacent utility line, so no utility upgrade is anticipated. The project, including the access road up to this building and a limited gravel parking area, would disturb about 12,000 SF of grassed area within the Accelerator Site north of the North Linac building.

2.2.7.1 No Action

This project is to centralize the storage of the RAD waste on the Accelerator Site where the majority of the waste is generated. No Action will continue transport of RAD waste to various existing temporary storage facilities located around the Jefferson Lab site and continue the inefficient operations that result from having multiple storage areas.

2.2.7.2 Alternatives Dismissed from Consideration

2.2.7.2.1 Construction and Operation of this Action at Another Location at Jefferson Lab

This project will consolidate the present RAD storage areas at Jefferson Lab onto the Accelerator Site where the majority of the RAD waste is generated. Currently, the majority of the RAD waste is stored off the Accelerator Site. Other locations on the Accelerator Site would require more roadway development for access than what is needed for the selected location. As well, access to utilities would be less conveniently located than those to be accessed at the selected site.

2.2.7.2.2 Construction and Operation of this Action at a Location Other than Jefferson Lab

This project is to support day to day Jefferson Lab operations and will not meet the program needs if performed at a location other than Jefferson Lab.

2.2.8 General Site Storage Structures

This project, to take place in two separate areas, will provide for the construction of approximately 9,600 SF of new general storage space consisting of two complexes that will be 40 ft. x 60 ft. pre-manufactured buildings to house equipment and components. Both sites are on the Accelerator Site. The first is the existing bulk storage area located near Canon Boulevard and the second is located behind the North Linac Service Building, just west of the proposed RAD building. The first site, an existing gravel hardstand area, would not require any additional service roads but has sufficient area for only two of the four buildings. The second site would require a new access road constructed along the rear of the North Linac Service Building, an extension of the road noted in 2.2.7 that will connect to an existing paved road. A continuous apron will be constructed along the front of the buildings which will facilitate access for loading and unloading to each building. All four buildings will be placed on individual concrete pads

with the perimeters sloped to provide drainage away from the buildings. As utility service for these buildings is minimal, the required utilities will be extended from an adjacent utility line, with no utility upgrade anticipated for either site. Construction at the first site would affect about 12,000 SF of gravel surface. Construction of the project at the second site, including the local parking and the road extending from the RAD building, would disturb about 15,000 SF of grassed area.

2.2.8.1 No Action

Jefferson Lab currently has one on-site storage building and approximately 70 shipping containers that it uses for storage. Experimental equipment is typically shipped to the Lab by the research-sponsoring institution for assembly. The components are collected and stored where possible and then moved to an experimental setup area for assembly. As some of the stored items require protection from the weather, No Action would require the continued use of shipping containers and temporary coverings for storage of these materials.

2.2.8.2 Alternatives Dismissed from Consideration

2.2.8.2.1 Construction and Operation of this Action at Another Location at Jefferson Lab

Locations off of the Accelerator Site were reviewed and deemed to be too inconvenient to the locations where the materials would be of most use. As a better fit to meet site needs for convenient storage, various locations on the Accelerator Site were considered.[1] These other locations on the Accelerator Site would require construction of more access roadway than would be required for the consolidated layout that also involves the radioactive waste storage building.

2.2.8.2.2 Construction and Operation of this Action at a Location Other than Jefferson Lab

Offsite storage is not practical because of the size of the material (transport on public roads can be hard to manage) and it would prevent regular access to stored materials. This project is to support Jefferson Lab operations and will not meet the requirement at a location other than Jefferson Lab.

2.2.9 North Connector Road Extension

This project is to extend the North Connector Road (north of CEBAF Center) from Rutherford Road to Rattley Road. This would connect the west and east sides of the campus area and improve access throughout Jefferson Lab. The project would disturb about 20,000 SF of wooded area.

2.2.9.1 No Action

No Action would place Jefferson Lab at risk during heightened security levels, since Jefferson Lab has two points of controlled entry. This requires staff to exit one secure area and enter another secure area to move from the north end of the site to the south end. The two points of entry increases security costs and reduces productivity of staff that need to progress from one end of the site to the other. Also, future increased staff and users on existing roads will increase safety risks during peak traffic times.

2.2.9.2 Alternatives Dismissed from Consideration

2.2.9.2.1 Construction and Operation of this Action at Another Location at Jefferson Lab

Due to the current location of existing roads and parking lots, the other considered locations for a connecting road would not provide access to as many parking lots and site exit points.

2.2.9.2.2 Construction and Operation of this Action at a Location Other than Jefferson Lab

This project is to support Jefferson Lab operations and will not meet the requirement at a location other than Jefferson Lab.

2.2.10 North Connector Road Parking Lot

This project is to construct a parking lot north of the existing North Connector Road. The parking lot would be constructed over an existing geothermal well field that provides cooling to CEBAF Center. The project would disturb about 60,000 SF of grassed area.

2.2.10.1 No Action

No Action would continue the traffic safety risk on Rutherford Road and continued use of a grass field for parking during periods of high occupancy, such as during conferences that utilize CEBAF Center for meetings, at Jefferson Lab. Almost the full length of Rutherford Road has parking on both sides. This requires drivers to back out of parking spaces directly onto the road creating a safety hazard.

2.2.10.2 Alternatives Dismissed from Consideration

2.2.10.2.1 Construction and Operation of this Action at Another Location at Jefferson Lab

Construction of the parking lot at other locations at Jefferson Lab would require additional disturbance of grassed and/or wooded areas and other locations would not be centrally located to such a large proportion of Jefferson Lab staff and users that will have workspaces in the local area.

2.2.10.2.2 Construction and Operation of this Action at a Location Other than Jefferson Lab

This project is to support Jefferson Lab operations and will not meet the requirement at a location other than Jefferson Lab.

3.0 NEPA REVIEW PROCESS

3.1 SUMMARY OF 1987, 1997, AND 2002 EAs

As mentioned in Section 1.1 of this document, DOE prepared an EA[2] prior to the construction and operation of CEBAF. The EA evaluated and compared the impacts of the construction and operation of a facility to utilize CEBAF technology as opposed to an alternative technology (i.e., pulsed linac with pulse stretcher ring), and considered alternatives to the proposed site at Newport News, Virginia (i.e., Charlottesville or Blacksburg, Virginia). In the 1997 EA, a proposed change in operating parameters of CEBAF and the operation of the FEL were reviewed.

In the 1987 EA, impacts were evaluated for the proposed operation of an electron beam in the range of 0.5 to 4.0 GeV beam energy with a maximum beam power of 1000 kW. In the 1997 EA, impacts were evaluated for operation up to 8.0 GeV while maintaining the 1000 kW beam power limit. The EA also evaluated the operation of the FEL for producing a laser beam up to 20 kW IR and 10 kW UV[3]. In the 2002 EA (DOE/EA-1384), impacts were evaluated for the construction of various site improvements and the proposed installation and operation of the Helios accelerator in the proposed FEL addition. At present, the Helios Accelerator has not been made operational and is not in the Laboratory's 2005 Ten-Year Site Plan, though plans to continue with the FEL addition are still underway.

DOE issued FONSIs for the 1987, 1997 and 2002 EAs. The 1987 EA identified short-term impacts to air quality, groundwater, soils, and ambient noise anticipated from construction activities. No major environmental impacts, or adverse effects on worker and public health, were predicted for either CEBAF construction or operation. Construction of CEBAF was completed in early 1995, and regular operations commenced shortly thereafter. The 1997 EA analyzed releases of radionuclides to the environment that could have adverse effects on worker and public health and any ecosystem, and it was determined that no substantial impacts would be expected from the operation of CEBAF or the FEL at the operating parameters noted above, and as construction would be minimal, there were no anticipated short-term impacts to air quality, groundwater, soils, and ambient noise. The 2002 EA identified short-term impacts to air quality, groundwater, soils, and ambient noise anticipated from construction activities. No major impacts or adverse effects on workers and public health and the environment were predicted from either the construction of new buildings or the installation and operation of the Helios accelerator at the FEL.

3.2 OTHER ENVIRONMENTAL REVIEWS

Since the 1987 EA and FONSI were issued, some modifications and alterations have been made to facilities and land areas at the Jefferson Lab site. These changes have included the construction of support buildings and other improvements to maintain CEBAF and FEL

[2] DOE 1987. An Environmental Assessment for the Continuous Electron Beam Accelerator Facility, Newport News, Virginia (DOE/EA-0257), January.

[3] DOE 1997. Environmental Assessment "Change in Operating Parameters of the Continuous Electron Beam Accelerator Facility and Free Electron Laser", Thomas Jefferson National Accelerator Facility, Newport News, Virginia (DOE/EA-1204), October.

operations. Before these changes were implemented, they were examined relative to activities covered in the 1987 EA to determine whether further environmental reviews were necessary. All actions were either categorically excluded using criteria in Subpart D of 10 CFR 1021, DOE NEPA Implementing Procedures, or determined to be part of the original scope of actions covered in the 1987 EA[4,5,6]. A new EA was prepared in 1997, as further discussed below, for the proposed increase in the maximum CEBAF beam energy up to 8.0 GeV and the operation of the FEL as described in Section 3.1.

The 1997 EA reported the results of an assessment of the potential for increased radiological releases due to increasing the CEBAF beam energy for the purposes of accelerator testing and operation, from energies up to 4.0 GeV with a maximum beam power of 1000 kW, to energies of 4.0 to 8.0 GeV with a beam power not to exceed 1000 kW as averaged over a one-week time period. This small variation in operating power level enables CEBAF operations staff to perform occasional small adjustments in beam current levels without exceeding established administrative and operational limits.

The three primary sources of potential impact identified and examined in the 1997 EA were: radiological impacts on occupational health, radiological impacts on public health, and induced radioactivity in groundwater. On examination in the 1997 EA, as the CEBAF beam power would not increase beyond the present level set for 4.0 GeV operations, no increase in radiological doses to workers was expected. In evaluating offsite radiological exposure, it was determined that skyshine radiation exposure, the chief source to members of the public, would not increase, but would likely decrease with the rise in beam energy to 8.0 GeV. Therefore, no increase in exposure to the public, even taking into account the small amount of additional airborne radiation that would be generated, would be expected. For the same reason, no effective increase in beam power, the activation of groundwater near the accelerator was expected to remain minimal but constant[7]. Therefore, the groundwater activity levels should remain well below the 5 pCi/ml (picocuries/milliliter) limit of the VPDES Permit that primarily addresses CEBAF operation[8]. Thus, it was determined that the action described in the 1997 EA and FONSI did not have the potential for causing impacts beyond those documented in the 1987 EA and FONSI.

The 2002 EA evaluated the potential environmental impacts from proposed construction of various site improvements and the proposed installation and operation of the Helios light source. The impact analysis in this EA focused on (1) the primary impacts due to some fairly large-scale

[4] SURA 1990. National Environmental Policy Act Documentation Review, Continuous Electron Beam Accelerator Facility, Newport News, Virginia, January 12.
[5] SURA 1993. National Environmental Policy Act Documentation Review, November 1989 to September 1993, Continuous Electron Beam Accelerator Facility, Newport News, Virginia, September 30.
[6] SURA 1996. National Environmental Policy Act Documentation Review, Continuous Electron Beam Accelerator Facility, Newport News, Virginia, August 26.
[7] Stapleton, G. et al. 1997. "Occupational and Environment Aspects of the Radiation Control Provisions at Jefferson Lab," Jefferson Lab Tech Note, JLAB TN 97-017, Newport News, Virginia.
[8] VPDES 2001. Virginia Department of Environmental Quality VPDES Permit No. VA0089320. U.S. Department of Energy, Thomas Jefferson National Accelerator Facility, Newport News, Virginia. Effective July 16, 2001 to July 16, 2006.

construction actions on surface water, air quality and noise; (2) the ultimate changes in site land use due to these actions including effects on terrestrial resources and storm water control and effects from building operations; and, (3) the installation and operation of Helios and the assessment of the potential radiological impacts to the public and workers and the potential for activation in the surrounding environment. On examination, further development of the DOE site identified minimal to moderate impacts to surface water if current storm water flows were not mitigated. The construction hazards evaluated were found to be typical for this type of activity.

In addition, the commitments reported in these EAs and their FONSIs were reviewed in the course of writing this EA to determine whether they had been addressed appropriately. All of the commitments identified in the three EAs were either performed in the course of ongoing activities, such as installing temporary shielding to limit radiation dose to the general public or, as needed, when the requirement for a new permit was identified. In line with the commitments in these EAs, current procedures are updated and new procedures are instituted as identified by Jefferson Lab staff and by the DOE. With commitments and BMPs in mind, the DOE has frequently interacted with Federal, State, and local agencies and authorities to stay informed of regulatory and policy changes that could affect Lab activities that include the operation of CEBAF and the FEL.

3.3 SCOPE OF THIS EA

This EA has been prepared pursuant to Section 102 of NEPA of 1969 (Public Law 91-190), as implemented by regulations promulgated by the President's CEQ (40 CFR, Parts 1500–1508, November 1978 and changes) and DOE NEPA Implementing Procedures (10 CFR Part 1021, April 1992 and changes). It is intended to:

- provide sufficient evidence and analysis for DOE to determine whether to prepare an Environmental Impact Statement (EIS) or a FONSI;
- assure that DOE complies with NEPA when an EIS is not necessary; and/or,
- facilitate preparation of an EIS, should one be deemed necessary.

Pursuant to Section 1508.9 of the CEQ regulations, this EA presents information and analyses of the proposed action and all reasonable alternatives. Section 2 describes the proposed construction actions and alternatives for each activity and notes some of the potential environmental impacts of each. Section 4 describes the existing environment and reports the environmental, safety and health impacts of the proposed action. The discussion of impacts includes a description of any adverse effects that cannot be avoided should the proposal be implemented, irreversible impacts, if any, and any mitigation measures needed to minimize adverse impacts.

The proposed action involves the projected upgrade and operation of the CEBAF and FEL accelerators and associated utility system expansions. Also included in this proposed action are the construction and use of other buildings and storm drainage and traffic improvements.[1] See Figure 2 for a site map showing the proposed locations for each of these projects. The improvements addressed in this EA will assist the Laboratory in making full use of this national physics resource by extending research capabilities with the upgrade of the accelerators and by better accommodating existing researchers, Lab technical and support staff, and expected additional research personnel.

Due to the variety of projects which affect the environment differently, the provided impact analysis is balanced around (1) the temporary impacts due to some fairly large-scale construction actions on surface water, air quality, and noise concerns; (2) the development, fabrication, and operation activities related to CEBAF and its associated Hall D complex actions, changed operation at existing Halls A, B, and C and the potential for radiological impacts to the public and workers and the potential for activation in the surrounding (on and offsite) environment during operations; and, (3) the ultimate changes in site land and resource use due to these actions, including effects on terrestrial resources, storm water management, and from building operations. There is little potential for adverse impacts from any of the following focus areas: long-term non-radiological air quality; geology and soils; floodplains; wetlands; or community resources including cultural and socioeconomic effects.

4.0 THE EXISTING ENVIRONMENT AND POTENTIAL ENVIRONMENTAL IMPACTS

4.1 INTRODUCTION

This section describes the community, human elements, and local environmental resources that contribute to make up the local environment that could be affected by the proposed action. These elements include regional setting and climate, general area land use, available community resources, natural resources, worker and public health and safety and potential impacts. Section 4.4 relates the potential environmental impacts that could result from this proposed action.

The proposed action will have various levels of impact, but note that all potential impacts and their mitigation are to be taken into account during all stages of this action, most importantly during the planning stage.

There is little potential for adverse impacts from any of the following focus areas: long-term non-radiological air quality; geology and soils; floodplains; wetlands; or, community resources including cultural and socioeconomic effects.

The proposed action is expected to have moderate to minor environmental impacts due to land disturbance during construction of all projects (temporary); moderate to minor impacts (to groundwater) from CEBAF and experimental area (Halls A, B, C) operation and resource usage; minor impacts from FEL and Hall D operation; minor additional impacts due to long-term land use, traffic, and building usage; and, minor safety and health impacts from all identified activities. (Note that temporary minor impacts due to noise, non-radiological air quality, and storm water quality during construction and potential negligible impacts to these same areas and ecology, floodplain and wetlands, and threatened and endangered species during long term facility use are expected.) There should also be no adverse impacts on geology and soils, cultural resources, socioeconomic and environmental justice concerns. There will be minor safety and health impacts from CEBAF operations and from the other varied activities, such as from construction, as covered under this EA. Thus, the impact analysis that follows, which includes items of regional and community concern, focuses on temporary land disturbance concerns, upgraded CEBAF and FEL operations, increased natural resource usage, and related potential impacts to air, groundwater, waste management, storm water management, other ecological resources such as trees and wildlife habitat, and human health.

The sites proposed for construction are within both non-developed and developed areas of Jefferson Lab. Construction in non-developed areas will take place at 3 locations with a total disturbance of approximately 9 acres. Construction in developed areas is at or in the proximity of existing structures and will result in about another 3.5 to 4 acres of disturbance at approximately 10 locations. Disturbance would affect a total of about 13 acres.

All comments received from reviewers of the draft EA have been satisfactorily addressed in this final NEPA document. Reviewer satisfaction was confirmed and is documented by the correspondence included in Appendix B.

4.2 REGIONAL AND LOCAL SETTINGS AND CHARACTERISTICS

4.2.1 Site Location

Jefferson Lab is located in Newport News, Virginia. Newport News is bounded on the east by York County and the City of Hampton; on the north by James City County and the City of Williamsburg; on the west by the James River; and, on the south by the Hampton Roads waterway. Jefferson Lab is located just east of Jefferson Avenue and is less than one mile to the west of Interstate 64. The site is just south of Oyster Point Road and just north of Middle Ground Boulevard. The general vicinity layout of Jefferson Lab is included as Figure 1. Two schools and railroad tracks serving the local rail system are located within one mile of the site. Newport News-Williamsburg International Airport is located two miles to the north. Figure 2 shows the Jefferson Lab site property and the proposed building sites for all structures identified in the Ten Year Plan that includes the structures identified to be constructed and operated in this EA.

Jefferson Lab is sited in the northern section of Newport News at an average elevation of 34 feet above mean sea level (MSL). The site elevation ranges from approximately 29 to 35 feet above MSL, which is above the 100-year floodplain level of 13 feet above MSL. The Jefferson Lab site is located in the coastal plain of the lower York-James Peninsula. The site is a part of the Brick Kiln Creek watershed, which discharges into the Big Bethel recreation area, a former drinking water reservoir, and the water then flows into the Chesapeake Bay. The entire Chesapeake Bay region is subject to the CZMA requirements, with specific applicability dependent on local jurisdiction. CZMA applicability is discussed in Section 4.4.3.

4.2.2 Local Climate

The weather of the Jefferson Lab site is strongly affected by the nearby marine environment. The Chesapeake Bay moderates the climate and weather of the site, with land-sea breezes dominating the wind patterns during much of the year. The mean monthly temperature for the Newport News area ranges from 4°C (40°F) in January to 26°C (79°F) in July. The record low temperature is -19°C (-3°F) and the record high is 40°C (105°F). Note that temperature values are based on information from the International Station Meteorological Climate Summary, Version 4.0[9]. Data is compiled using a 57-year history.

Normal annual precipitation is 112 centimeters (cm) [44 inches (in.)] spread evenly throughout the year. Extreme precipitation events, caused by hurricanes or tropical cyclones, have deposited as much as 29 cm (11.5 in.) of rain in a 24-hour period. As recorded by the National Oceanic & Atmospheric Administration at nearby Langley Air Force Base for the years1971 through 2001, the average annual snowfall is 5.8 inches. These records identify 2 days where extreme snowfall occurred: February 12, 1989 recorded 12.2 inches; January 3, 2002 recorded 10.5 inches. The highest recorded snowfall for this area for the period 1893 through 2005 was 30.0 inches, occurring on January 3, 1922. Because of the proximity of the Bay, fog is a common occurrence in the area. Heavy fog, reducing visibility to less than 0.4 kilometers [km (0.25 miles)], occurs an average of 23 days/year. Severe weather, in the form of thunderstorms, averages 37 days/year. Tornadoes are rare in coastal Virginia but may be spawned by severe

[9] Washington Post 2001. http://www.wpost.com/wp-srv/weather/longterm/historical/data/newport_news_va.htm

thunderstorms or when associated with hurricane or tropical cyclone activity. Hurricanes average less than one per year in Virginia, but have caused both wind and flooding damage to the area since colonial times[10]. Hurricane Isabel, in September 2003, disrupted Jefferson Lab'activities substantially.

4.2.3 Air Quality

The Jefferson Lab site is located in the Hampton Roads Intrastate Air Quality Control Region (AQCR) 223. The AQCR is in attainment with all criteria pollutants: sulfur dioxide, nitrogen dioxide, total suspended particulates, carbon monoxide, ozone, and lead, but remains a Clean Air Act maintenance area for ozone.

4.2.4 Site Conditions

The proposed construction areas, except at the site for the Hall D complex, are located on DOE property and do not have any known chemical, radiological, or other contamination in area soils, surface waters, or groundwater. The Hall D site is SURA property, but in support of the Hall D project, SURA is in the process of transferring 6 to 7 acres of SURA land to the DOE. The land being transferred has completely met all requirements under the Virginia Voluntary Remediation Program (VRP) and is well suited for this scientific research application. The details of the VRP are addressed in more detail below.

The 1987 EA, that addressed the complete DOE site, noted that the facility (Jefferson Lab was then named CEBAF) would be located on previously disturbed land, referring only to the developed areas around the few existing buildings. Although a new site specific environmental investigation was not performed specifically for the proposed action described in this EA, the DOE has determined that no new site investigation to support this proposed action is necessary at this time as there has been no reported spill or known contamination found on the DOE owned property to date. Also in support of this conclusion, groundwater monitoring on the Jefferson Lab site (consisting of 162.5 acres of land owned by DOE) has been performed since 1989 and has identified no water quality concerns. This DOE determination is based on these sources of information: the 1987 EA; on-site groundwater monitoring records from permitted wells[8,11]; results from sampling effluent at a permitted groundwater withdrawal point[12]; in support of the SURA land transfer to DOE, a comprehensive search of databases in November 2005 for local area information concerning Environmental Compliance, including the U.S. Environmental Protection Agency's Enforcement and Compliance History Report encompassing the last three years; environmental reports provided annually by the DOE to the public; and, Jefferson Lab staff knowledge. Information concerning the adjacent SURA property to be deeded to DOE is presented in the following paragraph. It is understood that conditions at each of the construction areas will be evaluated during the course of the excavation work, and if concerns are identified, appropriate mitigating actions will be taken as noted in Section 4.4.

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[10] Gale Research Company 1978. "Climate of the States", Volume 2, Detroit.

[11] VPA 1989. Virginia Department of Environmental Quality VPA Permit No. VPA01001. U.S. Department of Energy, Thomas Jefferson National Accelerator Facility, Newport News, Virginia. Effective June 16, 1989 to March 1, 1998.

[12] DEQ 2005. Permit to Withdraw Ground Water, Virginia Department of Environmental Quality Permit No. GW0047200. U. S. Department of Energy, Thomas Jefferson National Accelerator Facility, Newport News Virginia. Effective April 1, 2005 to March 31, 2015.

- The SURA property is part of approximately 50 acres of SURA and City of Newport News property registered in the Virginia VRP. The majority of this VRP property was the former BOMARC Missile Site. The May 1999 VRP Report determined that no further action was necessary to manage site conditions. A certificate of Satisfactory Completion of Remediation with deed restrictions was recorded in April 2000. The restrictive covenants on the VRP are: (1) The groundwater beneath the site shall not be used for any purpose other than environmental monitoring and testing, and (2) The site shall not be used for residential purposes.

In October 2005, a Phase I and Phase II Environmental Site Assessment (ESA) of the land to be transferred from SURA to DOE was conducted. The Phase II ESA determined the conditions at the (Hall D complex) site have not significantly changed from those described in the May 1999 VRP Report. Therefore, the Satisfactory Completion of the VRP is still in effect so no further actions to use the land for scientific research are necessary.

4.3 COMMUNITY RESOURCES

4.3.1 Demography and Settlement Patterns

The Jefferson Lab site is now part of the Jefferson Center for Research and Technology, and is situated just north of the Oyster Point Industrial Park.

The population of Newport News has steadily grown over the last 20 years, since documented in the 1987 EA. The U.S. Census Bureau estimated the 2004 population of Newport News at 181,913 as compared with 144,903 reported in the 1980 Census, a growth rate of 25%. The Metropolitan Statistical Area, that includes Norfolk, Virginia Beach and Newport News, was estimated by the U.S. Census Bureau to have a population of 1,637,251 in 2003, a 35% increase over the 1,201,400 documented in the 1987 EA.

4.3.2 Area Land Use

The local Oyster Point area, that included Jefferson Lab, was developed to serve industrial and business needs, and both City and industrial development continue throughout the area. The proposed actions will take place on land already dedicated to Jefferson Lab. The land making up Jefferson Lab is owned by the DOE, SURA, and the Commonwealth of Virginia/City as noted in Section 4.2.4. SURA plans to donate land to the DOE in support of the CEBAF upgrade, specifically for the Hall D construction. The land is adjacent to DOE property within the Oyster Point area. By land deed, SURA is restricted to use this land for support of DOE's CEBAF facility or for research and development. The land transfer is scheduled to take place in 2006.

4.3.3 Public Services

The City of Newport News has an adequate quality and quantity of public utilities and services provided by various organizations to support additional development at Jefferson Lab and in the surrounding area. The proposed action would extend these existing services as required, and will have a minor to moderate impact on current public services.

Natural gas is supplied by the Virginia Natural Gas Company and electrical service is provided by Dominion Virginia Power (power is brought onto the site by three feeder lines, one of which

supplies the 40 MVA master substation on the Accelerator Site). Water to serve site usage is provided by the City of Newport News Waterworks via three water mains. The HRSD handles sanitary waste, local area landfills accept generated trash, and various recycling outlets are available to handle these materials. Fire and emergency services are provided by the City of Newport News, with the closest fire station within one-half mile of the site.

Water service for the new buildings and accelerator support facilities will be connected to the existing water distribution system on the Accelerator Site. Most of the new facilities are non-occupied except for the TSB2 and the Hall D complex Counting House. The planned occupants of the TSB2 will primarily be relocated from existing trailers on the Jefferson Lab site, with a minimal increase in the site wide population. Little increase in the usage of domestic water and sanitary sewer system from adding the new structures will result. Domestic water usage will be increased to meet the higher cooling needs resulting from the new operating levels of the two accelerators, but the existing main supply lines are adequate to support these needs.

Power usage will increase due to the CEBAF upgrade running at higher energies, but no modifications or upgrades are required for the existing three feeder lines.

4.3.4 Transportation

All vehicles traveling to the site gain access by way of Jefferson Avenue (Route 143) with a special use access entrance via Canon Boulevard. Both public roads are capable of supporting current traffic loads. Operating the upgraded accelerators and the new structures will result in a minor increase in road usage by employed personnel and delivery vehicles. During construction, the majority of construction traffic to the site of the Hall D complex will be via Canon Boulevard, with associated Lab staff and others involved with the construction entering through Jefferson Avenue. A minimal increase in area traffic will occur locally during the different construction projects, and will return to pre-construction levels upon completion of each project.

4.3.5 Economic Structure

The 1987 EA reported that there were over 150,000 people participating in the Virginia Peninsula labor market. The City of Newport News Department of Planning and Development has updated that figure so that it is estimated that there are 774,000 people currently participating in the highly diverse Peninsula labor market. Note that the word “Peninsula” refers to all cities and counties south of Williamsburg. Newport News firms draw employees from across the Peninsula, the Norfolk-Portsmouth areas, and other areas within driving distance. Service, manufacturing, technical, sales, and administrative support positions make up a majority of the work force.

Labor for proposed construction projects would be drawn, project by project, from the area labor pool by the respective subcontractor. Minimal new Jefferson Lab staffing is expected, as practically all the labor to staff the new structures and to operate the upgraded CEBAF and FEL would be drawn from the pool of JSA staff and visiting researchers that are already working at or are involved with Jefferson Lab. Therefore, only minor impacts to the local population, services, and economy would be expected during the larger construction projects; otherwise only small impacts would be expected.

With regard to environmental justice, there would be no disproportionate adverse impacts on minority and economically disadvantaged populations in the Newport News area because no major adverse impacts are expected from any aspects of the proposed actions.

4.3.6 Historic, Aesthetic, and Cultural Resources

No previous investigations have been performed to determine the presence of subsurface historic or archeological features. This was based on a Virginia Historic Landmarks Commission determination that one was not needed, as cited in the 1987 EA. The Project Review Supervisor at the Commonwealth of Virginia Department of Historic Resources (VADHR) advised DOE in 1992 that no adverse impacts to archaeological and historic resources would be expected from activities at Jefferson Lab. It was also documented that no survey was required when the 1997 EA was prepared. Major construction has occurred since 1987 and no trace or sign of historic or archeological value has been noted.

The local peninsula area has a vast array of cultural and historic resources, with none in the immediate vicinity of Jefferson Lab. The current facility has preserved some visually pleasing original vegetation buffers along the periphery of the site. Landscaping around buildings and along the main site entranceways is performed for aesthetic reasons.

There will be no impacts to any historic or cultural resources, so no mitigations are needed. If an item or evidence of an area of historic significance were found during this project, no further activity in that area would be taken until notifications to appropriate agencies were made and an acceptable mitigation strategy was arranged. As for aesthetics, a portion of the vegetation buffer near the south and the new east DOE property lines near Canon Boulevard will be removed under this proposed action. This is addressed in Section 4.4.1.2.

4.3.7 Not Applicable Considerations

The following areas of interest were verified as being not applicable when DOE/EA-1384 was finalized in June 2002 and are considered not applicable considerations for this action: Federal or State listed rivers or have an impact on existing or planned recreational facilities, existing or planned transportation facilities, Virginia forestlands, prime farmland, Native Americans, aesthetically important areas, scenic rivers, and special natural resources such as aquifers.

All agencies will have been provided the opportunity to alter these determinations with the provision of this draft EA.

4.4 RESOURCES AND ENVIRONMENTAL IMPACTS

This section presents the expected level of environmental impacts for each resource considered for this proposed action. The main focus areas are the standard impacts from temporary construction activities and long-term standard facility operations (Section 4.4.1), and special impacts related to the increase in beam power to operate both the CEBAF and FEL accelerators and to the operation of related support structures and equipment (Section 4.4.2). Areas with very minimal or no impact, and needing no further consideration, are noted in Section 4.3.7. Impact information on specific species, flora and fauna, is discussed in Section 4.4.12. The DOE advocates P2 and energy efficiency (E2) principles that include source reduction, operational

efficiency, waste minimization, and EPP. Therefore, the DOE intends to integrate these principles into all phases of the proposed action.

This assessment takes into account that, by implementing the above principles and the general performance criteria provisions of the Chesapeake Bay Preservation Area Designation and Management Regulations (CBPADMR), the impacts to the environment will be minimized to the extent possible (Section 4.4.3). The CBPADMR provisions include minimizing erosion potential, reducing the land application of nutrients and toxics, maximizing rainwater infiltration, and ensuring that these performance criteria are incorporated in a long term site strategy.

4.4.1 Impacts Related to Land Use and Standard Facility Operations

Land use to support a new research area (Hall D) and storm water management and transportation improvements on the Jefferson Lab site will affect about an additional 9 acres of mostly wooded land. About four acres of additional already developed areas, such as for utility upgrades, will also be affected. All the land is already zoned for research and development which is consistent with local land use planning strategies. As stated above, the existing utility services to Jefferson Lab are adequate to meet the needs of the proposed action, but the action includes modifications to the Jefferson Lab owned portion of the utility distribution systems. No unusual land-use environmental impacts than are normal with operating a research institution are anticipated with the proposed actions. Jefferson Lab's Environmental Management System (EMS), aligned with the International Organization for Standardization (ISO) 14001:2004 *Environmental Management Systems – Requirements with Guidance for Use* and DOE Order 450.1 *Environmental Protection Program,* combined with DOE environmental programs, integrate environmental protection considerations into daily facility operations. All potential impacts of activities resulting from the proposed action will be addressed as a matter of course under the Labs EMS. Specific potential impacts on water, air, and other resources are addressed individually in Sections 4.4.4 through 4.4.12.

4.4.1.1 Conventional Construction Effects in Developed and Non-Developed Areas

The proposed conventional construction is expected to have moderate to minor impacts on the environment but would not change the industrial nature of the Accelerator Site nor the office/industrial nature of the campus area. The potential impacts associated with conventional facility construction are temporary and long term increased storm water runoff, erosion, and potential spills from handling of oil and/or hazardous materials. The impact varies with each proposed action due to the location and the amount of land disturbed. The proposed actions will take place within the existing developed and non-developed areas of Jefferson Lab. Refer to Figure 2 for the site map indicating the proposed locations for the projects/actions involved.

The proposed construction projects directly related to the upgraded CEBAF and FEL operations that are within existing developed areas consist of the second Central Helium Liquefier (a 4,800 SF building), various small service building additions, and a Utility Infrastructure upgrade which includes cooling tower pads and new above and below ground utility corridors. Other buildings that will be constructed in already disturbed areas are the TSB2, the Low-Level Radioactive Waste Handling Storage Building, and the General Site Storage Structures. Another site action in a developed campus area is the construction of the North Connector Road parking lot.

The Hall D complex, which is directly related to CEBAF operations, the East and West Retention Ponds, and the North Connector Road Extension will affect three separate areas of non-developed land on Jefferson Lab. The East Pond and the Hall D complex are in close proximity to each other.

As stated earlier, the Hall D complex and the East Retention Pond will be located on both DOE and currently SURA owned property (see Figure 2 in Section 2). All the remaining proposed actions are on DOE property. There is no known chemical or radiologically contaminated soil or groundwater within the proposed construction sites on the DOE property. As stated above in section 4.2.4, the SURA property is enrolled in the Virginia VRP with a Satisfactory Completion of Remediation recorded in April 2000. The VRP Report found that neither construction restrictions nor additional sampling is required for construction anywhere in the designated area, including the proposed location for all Hall D facilities.

If any unusual materials are encountered at any of the construction sites, either on or off the Accelerator Site, sampling will be performed to identify possible contaminants. If any are identified, all appropriate means will be taken to remove contaminated materials and provide for proper disposal. Also, radiation control staff will check earth removed from any excavation in the proximity of an accelerator enclosure or building in the normal course of work. Radiation control staff will verify that no special soil handling precautions involving potential radioactive materials are necessary, though if a problem is identified, the soil will be collected per site procedures and disposed of as a low level radioactive waste. Refer to Section 4.2.4 for more information on existing site conditions in the Hall D vicinity.

Construction activities and the resultant disturbance will be separated by both location and phasing and would be spread over a number of years. Each specific construction activity would range in duration from six months to two years. All new structures and their associated parking will have a moderate impact on local drainage patterns, so surface water and storm water concerns are addressed in Section 4.4.4. A Jefferson Lab site wide storm water management study was completed in February 2003 that identified capital investment needs of three regional retention ponds to manage increased storm water runoff from future developments. Construction of one pond is complete and the other two ponds are addressed in this EA. Air and noise quality impacts, potential transportation effects, and waste management implications resulting from construction activities are also considered and are presented starting at Section 4.4.8.

In order to integrate environmental stewardship and P2 principles into the construction phase, facility designs will incorporate sustainable design principles to the maximum extent possible within the project budgets. DOE intends to perform the following: include related guidance and directives in the building design scopes and encourage and support opportunities to conserve natural resources during design and construction and during long term operations that could aid in minimizing impacts.

4.4.1.2 Long Term Effects from Land Use and Standard Building Operations

The multiple construction projects will involve the disturbance of about 9 acres of mostly wooded land and about 4 acres of already developed land resulting in the permanent removal of

approximately 6 acres from serving its natural drainage function and habitat for wildlife. Some of the disturbed land will end up reducing local wind and noise buffer zones. The impacts due to the change in local land use and utilizing the new buildings are considered here. The proposed changes are needed to support Jefferson Lab operations and the land disturbance is typical of that occurring throughout the local area. The entire Oyster Point area, including the Jefferson Lab site, is zoned for research and development activities. This means that continuous industrial-related development by Jefferson Lab, the City of Newport News, and by neighboring businesses is a normal process. Jefferson Lab, through long range planning, attempts to minimize land disturbance. Jefferson Lab utilizes BMPs to optimize building and parking layouts to minimize negative effects to the environment.

The designers for each facility will utilize sustainable design principles to incorporate healthful and environmentally beneficial features into the structures. The Jefferson Lab EMS, aligned with ISO 14001, encourages reducing waste at the source, promoting the reuse of items, and recycling to the maximum extent. These principles will be emphasized by line management and integrated into the building designs to the extent possible.

Also in place is the Lab's Spill Prevention, Control, and Countermeasure (SPCC) Plan, the site program to minimize spills. The contractor's EH&S Manual documents the procedures for the proper handling and storage, including secondary containment, for chemicals and/or waste materials stored outside.

Jefferson Lab's EMS includes a VPDES general permit for Small MS4s, a site wide SPCC Plan to minimize spills from any oil-containing items, and an HRSD permit for discharges to the sanitary sewer system. Each of these programs has established procedures and usually BMPs to ensure compliance with Federal and Commonwealth laws and improve environmental performance and stewardship.

Proposed building use for most new facilities would be typical to that already covered for existing standard industrial and storage type buildings, so no special considerations need to be addressed for long term use. Those new facilities that have non-standard long term or usage impacts are described below.

- The Hall D complex and the East and West Retention Ponds will impact the depth of forested buffer along the property lines of Jefferson Lab. The site layout at the Hall D complex, which is adjacent to Canon Boulevard, will be optimized to the maximum extent possible to maintain a natural forested buffer.
- A 4,800 SF building extension is to be added to the existing CHL building to house the refrigeration compressors of CHL #2.

- The Low Level Radioactive Waste Storage Building would allow for radioactive waste processing and storage to occur inside an enclosed structure with a controlled atmosphere. Usage would be managed under existing site procedures. The use of this new structure would minimize the likelihood of the spread of potential radioactive contamination with the current situation for processing radioactive waste and storing activated materials outdoors and exposed to the elements.

Note that all potential impacts regarding land use, building and site layouts, and building operations will be mitigated and addressed during planning and incorporated into the individual project scopes. Factors that could have long-term effects due to the upgrade of CEBAF and FEL accelerator operations are discussed in 4.4.2.

4.4.2 Operational Impacts from CEBAF/FEL Upgrades

4.4.2.1 Research & Design (R&D), Fabrication and Installation

R&D and fabrication efforts to support the CEBAF and existing experimental area upgrades will take place within existing facilities, activities that are performed as part of normal site operations. Installation of equipment in support of the CEBAF, FEL and experimental area (Halls A, B, and C) upgrades will be transitory and of short duration involving subcontractors and in-house labor and equipment. There will be expanded site activity, but minimal additional environmental impact to the site is expected. Similar tasks involving R&D and fabrication will occur to support the FEL upgrade and the CHL expansions. Best management practices to minimize resources and disturbance will be incorporated in the planning process.

Note that structures to be built and equipment to be fabricated in support of the CEBAF and FEL upgrades are typical of the Lab's current industrial type buildings and equipment, and any special environmental, health, or safety considerations will be addressed as identified in procurement specifications. Equipment procurements related to utility upgrades are standard activities that occur on an ongoing basis and may make use of standard or custom manufactured equipment provided by offsite vendors that would not result in any impacts that need review. Those new buildings/facilities that have non-standard operational impacts are described in the next section.

4.4.2.2 Commissioning, Operating & Maintenance

In the long term, commissioning, operation, and maintenance of the CEBAF, FEL, experiment areas, and associated support buildings are expected to have minimal additional environmental impacts to the site. The proposed upgrade to CEBAF would typically reflect current operating conditions. The factors that could have long-term environmental effects at any of the proposed accelerator related activities are considered in the discussions below.

- CEBAF: The only expected impacts on water quality due to accelerator operations will be radiological, so there should be no non-radiological impacts on local surface or ground water, including from the dewatering effluent.

  Surface Water – Impacts Not Involving Radiation

  Erosion and sedimentation to onsite storm water channels and storm drainage systems, including at local roadways, could result from land disturbances during on-site construction activities and will be controlled by implementing standard erosion control measures, as specified in construction subcontracts, until stabilization is complete.

The described further development on the DOE site could result in minimal to moderate offsite impacts to surface water if changes in storm water flows are not mitigated. The retention ponds being added under this action implement recommended measures that would offset impacts due to this and other potential facility growth, and should negate or minimize any offsite impacts.

Impacts from radiation from this action are not expected, as discussed in the Radiological Impacts section titled "Surface Water" below.

Radiological Impacts – All Waters that Could be Affected by Radiation

Generally, radiological effects on groundwater and surface water from upgraded CEBAF operations, including at the three existing experimental halls, Hall A, Hall B, and Hall C, and at the new Hall D, will continue to have the potential for minor impacts to ground and surface waters. Impacts to ground and surface water from upgraded FEL operations will be negligible. The effects on surface waters include negligible impacts from the controlled discharges of activated waters to the local sanitary sewer system. Any impacts will be mitigated as described below.

Groundwater

Activation by prompt radiation from CEBAF operation is directly proportional to the operating electron beam power. The new proposed CEBAF operating level is up to 16.0 GeV at the increased beam power limit of 2 MW for the recirculating linac region of the accelerator, up from the current 1 MW anywhere within CEBAF. The 1 MW power limit to each of the main locations where groundwater would have the highest probability of becoming activated, the Hall A and C HPBDs, would not change**.** There will be effects, but as the power does not change, no substantial change in the quantity of groundwater activation products would be anticipated.

As operational levels will change, appropriate shielding will be installed at both Halls A and C, including at their HPBDs, to reduce the probability of impacting groundwater. Negligible impacts on soils or groundwater in the vicinity of the halls from prompt radiation are expected.

Hall B, with one beam dump, and the proposed Hall D, with two beam dumps, only accept low power beam, and thus operations would result in none to negligible impacts to groundwater. Shielding would be installed to reduce any chance of groundwater activation, including at the two beam dumps at Hall D. No impacts to soil or groundwater are expected.

Process Water

The generation of radioactive wastewater is expected to slightly increase with CEBAF accelerator operation under the proposed parameters. Sources of activated water include the HPBD cooling water and the dehumidification condensate at Halls A and C. An increase in activity at these locations, and at the new activity sources at the Hall D beam dumps, is expected with this proposed CEBAF upgrade. This water will be managed under the current program using the controlled discharge of small

quantities of this water to the public sewer system, and ultimately to surface waters, in accordance with the Lab's HRSD permit.

Because these increased levels of activity can be managed under the current site program, no additional impacts for addressing this activated process water are projected for operation under the proposed parameters. Materials that would be collected for discharge that are outside of permit criteria would be disposed under controlled conditions as low level activated waste, a minimal, not expected, impact.

The non-routine release of HPBD cooling water or other source, dehumidification condensate, or low-conductivity cooling water could introduce radioactivity into soils and groundwater. The proposed changes in CEBAF operating parameters would not change the nature and quantity of radionuclides in any of these sources. Therefore, even if an unplanned event (such as a spill/release of beam dump cooling water) were to occur, impacts would be the same as those from current CEBAF operation at 8.0 GeV.

Surface Water, Including that to the Sanitary Sewer System

The only potential radiological impacts to the surface water are from accelerator sump pumps located throughout the accelerator complex, the groundwater dewatering activity at the halls described in Section 4.4.4.3.1, and from the indirect discharges of activated water to the sanitary sewer mentioned above. The water from the accelerator area sumps is collected, and if it does not meet standard surface release requirements is disposed offsite as activated water. Discharges from any new facilities would be managed under current site programs. As all releases to the surface are managed under current programs, there would be only minimal additional impacts to surface water from the possible increased quantities of activated water released to the sanitary sewer.

- CHL:

  The CHL #2 helium refrigeration equipment will be powered by large oil flooded screw compressors which will house approximately 250 gallons of oil each with a total inventory of 1,500 gallons. Component isolation valves, oil recovery containment, and established procedures limit the amount of possible oil spillage during maintenance and repair and ensure the environment is not affected. The water from the new cooling towers will be discharged to the surface in a manner similar to that of the existing cooling towers for CHL #1. Permits will need to be updated accordingly.

  Localized internal building noise levels could reach 107 decibels (dBA) but will be attenuated to reduce the noise below standards which require hearing protection and will not have any external building noise impact on the environment. The compressors are of the oil flooded screw compressor design and will house a total of 1,500 gallons of oil. Oil containment features will be designed into the building construction to contain accidental oil spills from affecting the environment.

- Halls A, B, C, and D: The water from the new cooling towers for Hall D will be discharged to the sanitary sewer. The HRSD permit will need to be updated accordingly.

- Associated Buildings: The water from the new cooling towers to support the upgraded utilities for the CEBAF upgrade, except for possibly those for CHL#2, are expected to be discharged to the sanitary sewer. The HRSD permit will need to be updated accordingly.

- FEL:

  FEL Operations

  The FEL facility is a light source that uses the high quality superconducting radiofrequency (SRF) electron accelerator technology used in CEBAF to produce high average power IR and UV light. Environmental concerns are similar to those of CEBAF. However, the innovation in this accelerator configuration is in electron beam energy recovery whereby most of the electron beam energy is recovered in the form of RF. This feature greatly reduces the generation of residual radioactivity.

  Outdoor FEL Light Propagation

  Outdoor propagation of FEL light to determine atmospheric attenuation effects will require control of non-ionizing radiation onsite and insurance of no impact on nearby airports. The proposal is to mount target/diagnostic equipment on-site at a height of less than 50 feet and at a distance of not more than 2 km from the source building (FEL). The goal is to have the capability to send the beam to and from the target. This would require a penetration on the roof of the FEL from which the beam would exit. It would then reflect off a mirror to direct it horizontally to the target. The mirror controls would be constrained so that the beam could not stray off the target. A non-hazardous detection device interlock is under consideration that will turn off the beam to prevent flying objects from intercepting the laser beam. The FEL is the first electron based accelerator that fully utilizes energy recovery whereby the electron beam energy is completely recovered with the exception of the initial energy of the injector, which is about 9 MeV (million electron volts). This ensures minimization of residual radiation produced in the electron beam dumps. The photon beams produced by the free electrons lasing (the IR and UV) are all completely contained in their own beam dumps that produce only heat. Standard precautions for class 4 lasers are in place and an integral part of FEL operations.

4.4.3 Coastal Zone Management Act (CZMA) Considerations

4.4.3.1 CZMA as implemented in Virginia as the CBPADMR

All of the relevant regulations under the CZMA, as implemented in the Virginia CBPADMR that could apply to the activities described in this proposed action, have been taken into consideration in this EA. According to City of Newport News Department of Planning and Development correspondence (dated April 25, 2001, included in Appendix B), there are no areas on the Jefferson Lab site that are designated as either a Resource Protection Area (RPA) or a

Resource Management Area (RMA) under the CBPADMR. As further documentation of the site status under the CBPADMR as requested by the DEQ, an area review to determine the presence of RPA features was performed in early 2002. This review clarified that there is at least a 500 foot separation between the DOE site and any designated RMA so that the site does not encroach upon any RMA or RMA buffer zone, and this was confirmed with the DCR in 2006. The local RMAs are located as shown on Figure 5. Area soil maps indicate that there are no City of Newport News defined "highly erodible soil" types on the Jefferson Lab site. As this was the only potential RPA or RMA feature on the site, it is concluded that there are no RPA or RMA features that need attention under the CBPADMR.

The site is situated on a coastal plain where operations and use of TJNAF could potentially have a small impact on downstream CZMA designated areas. The resources described in the relevant CZMA regulations, and how DOE is addressing them and any necessary mitigation measures in regard to the proposed action, are discussed below. Based on this EA review, it appears that there should be no adverse impacts to any of the resources described under the CZMA, which includes resources in any designated Chesapeake Bay Preservation Area (CBPA).

4.4.3.2 CZMA Consistency Certification

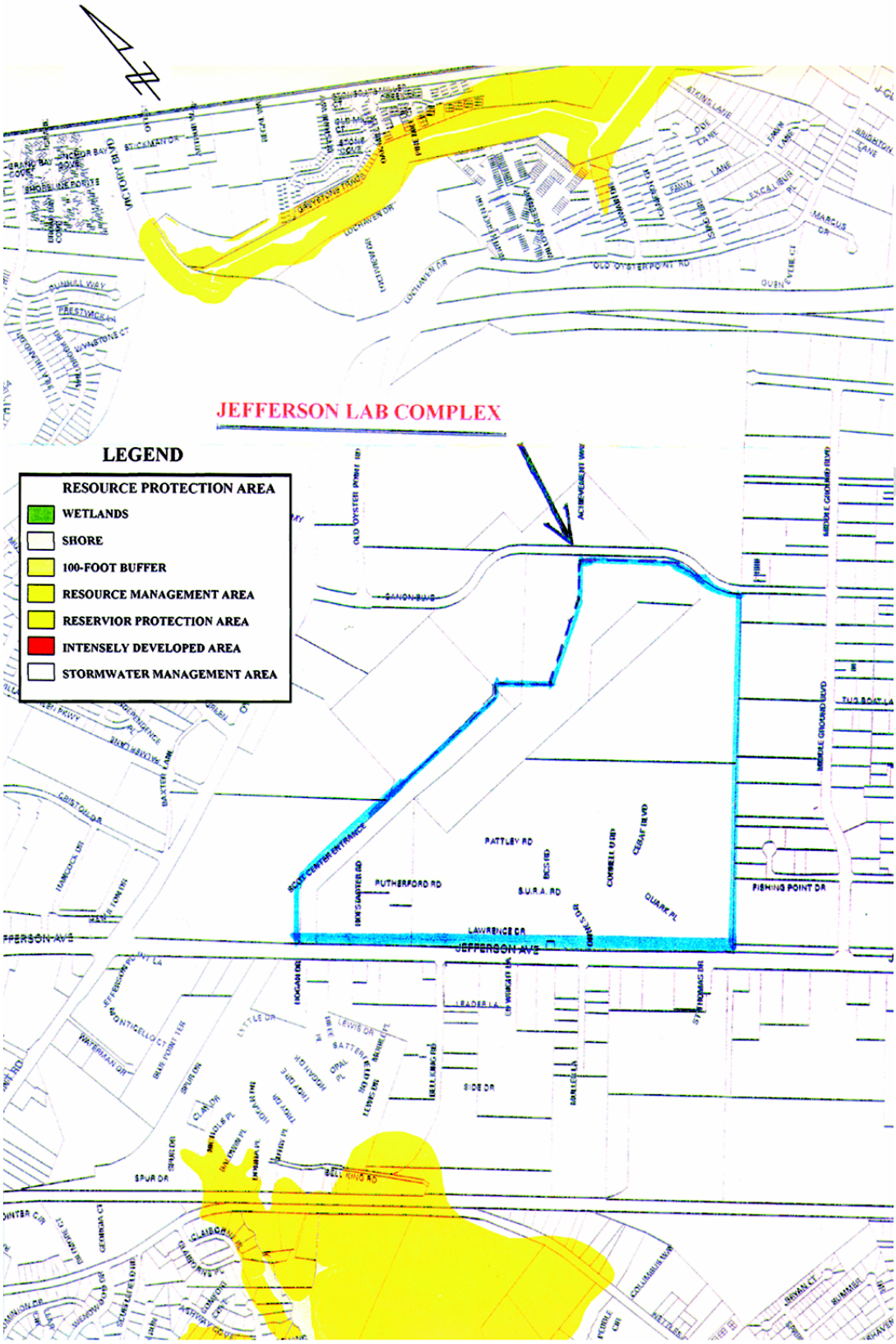
Although the Jefferson Lab property does not fall under the purview of the applicable Virginia law, the CBPA, the requirements of the CZMA have been reviewed. To be consistent with the CZMA programs, the DOE intends to obtain all applicable permits and approvals listed in the Virginia program prior to commencing any of the actions described within. Upon granting of a permit or other approval, the DOE affirms that it will comply with any identified terms and conditions, as well as with the goals and objectives of the CBPADMR and other relevant regulations, to the maximum extent practicable. How the requirements of the CZMA are being addressed regarding this proposed action is discussed here.

The applicable Regulatory Programs that require addressing under the CBPA and Virginia's Coastal Resources Management Program (VCP) follow.

- Coastal Lands Management: The Jefferson Lab site in Newport News has not been designated by the local government as a Chesapeake Bay RPA or RMA, as defined in §10.1-2107 of the CBPA. This was documented in correspondence dated April 25, 2001, which is included in Appendix B. The average site elevation, of roughly 32 feet above MSL, places Jefferson Lab outside of the nearest RMA. Refer to Figure 5 for the locations of local RMAs.

  By taking due care to avoid, or minimize as possible, the discharges of sediments from any of the construction areas, no impacts beyond the immediate construction areas are expected, so there should be no chance of any effect beyond the site boundary. As part of the VPDES general permit for a Small MS4, Jefferson Lab utilizes BMPs to manage construction site storm water runoff. Also, Jefferson Lab has a VPDES General Permit for Storm Water Discharges from Construction Sites that is applicable for construction activities affecting one or more acres. As there are no RMA or RPA areas in the vicinity, the Lab does not have to have such a permit for disturbances of 2,500 SF or more. In accordance with this permit, for applicable

projects, a site specific Storm Water Pollution Prevention Plan (SWP3) will be developed and controls put in place prior to any land disturbing activity. For all land disturbing activities, erosion and sediment controls are aligned with Virginia's
635 Erosion and Sediment Control Handbook to manage potential impacts. All proposed actions will be in accordance with these established permits. With these established controls, there is effectively no chance of any impact to downstream coastal areas of concern.



640 **Figure 5** - Jefferson Lab Area RMA Map

- Wetlands Management: The entire site, including SURA land, was reviewed for wetlands as identified in the Wetland Delineation and Threatened and Endangered Species Survey[13]. As land disturbance will be strictly limited within the defined construction sites, there will be no impact on adjoining on-site areas and, therefore, no impact that would disturb or otherwise affect any other wetlands that could be in the general vicinity of the laboratory. Discharges from building operations, if any, will be directed to existing storm channels and should have no adverse effect on any downstream wetlands. As no offsite impacts are expected from construction or operations, no coastal or other wetlands should be affected by this proposed action.

- Non-point Source Pollution Control: All construction projects will be managed for erosion and sediment control (E&SC) in accordance with Jefferson Lab's VPDES General Permit for Storm Water Discharges from Construction Sites. As stated above, a site specific SWP3 will be developed and augmented with information from the applicable construction subcontractor. The controls are tailored to the site conditions and are aligned with Virginia's Erosion and Sediment Control Handbook to manage potential impacts. The potential impacts vary for each proposed action based on the amount of land that will be disturbed and the controls will be scaled appropriately. E&SC plans will be required, and an SWP3 filed with our VPDES Permit for each individual activity that disturbs one or more acres of land. All jobs involving land disturbance are reviewed and E&SC measures are implemented where identified. Proper E&SC practices, to be overseen by an inspection program, will ensure that impacts are restricted to within the limits of construction for each activity. No other disturbance to the Jefferson Lab site beyond the construction limits is expected. There should be no non-point sources affecting surface water from building use; therefore, no offsite effects at any downstream locations are anticipated.

  Jefferson Lab has a program for the management of storm water. Storm water runoff from the areas on Jefferson Lab subject to disturbance under this EA is conveyed by a series of vegetated open storm channels and pipe culverts to either Canon Pond (east of the site) or the Oyster Point Drainage Ditch (south of the site) that ultimately discharge into the Big Bethel recreation area and the downstream Chesapeake Bay. A small portion of the site drains along Jefferson Avenue on the west side of the site. Jefferson Lab is relatively flat and primarily hydrologic soil group D (slow infiltration rate). A site wide storm water study was completed in February 2003 of the Jefferson Lab complex of approximately 225 acres – federally owned property (162 acres), SURA owned property (44 acres), City of Newport News owned property (11 acres) and Commonwealth of Virginia owned property (8 acres). The study identified the two major watershed areas, maintenance requirements of the existing storm drainage system, and regional retention ponds to control the increased storm water runoff with future developments. The developed conditions modeling for the study utilized the program entitled Hydraflow Hydrographs 2002 by Intellisolve. The program is based on U.S. Soil Conservation Service (SCS) method Type II rainfall distribution, 24 hour

[13] REMSA, Inc. 2001. Wetland Delineation and Threatened and Endangered Species Survey, Newport News, Virginia, August.

duration. Construction of one retention pond is complete and the other two ponds identified by the study are part of this EA. As part of the continued design of these ponds, the developed conditions model will be updated to ensure the latest information[1] is reflected. It should be noted that the two ponds included as part of this EA are sized to match the needs identified[1] and other future developments that are not identified in this EA.

- Point Source Pollution Control: No more than minor impacts would be expected from these possible point sources, as the discharges would be no different from those already addressed under existing programs. These programs are in addition to the storm water pollution prevention program discussed above and include HRSD permits and other site programs addressing spill control and accident prevention. Any identified dewatering or cooling tower discharges would likely be incorporated into an existing site permit, with new permits obtained if necessary. No offsite impacts are expected.

  (1) Construction: The construction point source discharges are temporary and non-storm water discharges will vary with each proposed action. The sources typically are from the following construction activities: dewatering to accommodate in-ground construction, pipe flushing, hydrostatic testing, washing, and dust control. Many of the erosion control measures for these activities are similar to those used for storm water. Only the Hall D complex construction is expected to have temporary dewatering, vehicle washing, and dust control activities. The potential impacts are moderate to minor and will be managed with the BMPs established as part of existing permits tailored for each proposed action.

  (2) Installation, Commissioning, Operation & Maintenance: The types of activities that could potentially result in point source discharges involve equipment fabrication, such as the production of the superconducting cavities and the resultant wastewater discharges and small amounts of hazardous waste generation, though only minimal changes from current operations are expected. Setting up equipment that includes oil-filled transformers and cooling towers could lead to spills. All such fabrication and set up activities that involve potential impacts will have controls incorporated into the activity during the planning and design phases.

  Effects from CEBAF and FEL accelerator commissioning, operations, and maintenance would vary from current operations but control measures will be included in the planning and incorporated into the facility design. Water and power requirements will have moderate increases to support CEBAF operations. Water and power requirements to support FEL operations will increase minimally. New cooling towers will be the primary reasons for this expanded water usage.

System and building operations and maintenance would be no different from current operations as all storage and movement of materials is handled under site programs. For example, potential spill sources, such as oil-cooled substations, will be built using secondary containment or other suitable BMP. It is expected that the discharges from the new cooling towers will be handled through the HRSD system except for the towers for CHL #2, which will likely go to the surface. Conditions will be reviewed after operations begin to determine final discharge points for all new towers.

- CEBAF – The six new electrical oil cooled substations to be added are recognized as potential spill sources. The new units substations will be constructed with secondary containment to address spill potentials.

- CHL #2 - The water from the new cooling towers will be discharged to the surface in a manner similar to the existing cooling towers for CHL #1. The discharge rate at the existing cooling towers is 0.019 cfs (cubic feet per second). It is anticipated that the new cooling towers for CHL #2 will double the amount of discharge. The estimated discharge is small, especially compared to storm water runoff; therefore, there would be no potential impacts. Permits will need to be updated accordingly.

- Halls A, B, C, and D - The water from the new cooling towers for Hall D will be discharged to the sanitary sewer in a manner similar to the that for other experiment hall cooling towers. The HRSD permit will need to be updated accordingly. No potential impacts would occur.

- FEL – The water requirements and discharges for the FEL facility will increase minimally, but discharges are completely self-contained in standard facility plumbing connected to the HRSD sewer system.

- Associated Buildings - The water from the new cooling towers at the North and South Access Buildings, that will support the CEBAF upgrade, will be discharged to the sanitary sewer in a manner similar to that of the existing cooling towers. The HRSD permit may need to be updated accordingly.

- Air Pollution Control: No local or regional impact on National Ambient Air Quality Standards (NAAQS) parameters is expected from the construction activity; however, the need to monitor emissions during construction, as prescribed under the new particulate rules, will be evaluated prior to the start of any land disturbance. Monitoring for particulates is not expected to be necessary for standard building use or from CEBAF and FEL upgrade operations. Refer to Non-Radiological Air Quality in Section 4.4.7.

The Jefferson Lab site is not directly adjacent to beaches or tidal areas, so a number of enforceable regulatory programs comprising the VCP do not apply and therefore

are not addressed here. These not applicable programs are: the Fisheries, Subaqueous Land, Dunes Management programs, and Shoreline Sanitation.

No potential downstream effects on Coastal Natural Resource Areas and other shorefront property identified in VCP Advisory Policies are expected. Refer to the sections above on how non-point and point source pollution control shall be addressed.

4.4.4 Water Resources

The facility site is located on the York-James peninsula, situated between the York and James Rivers, part of the eastern Coastal Plain of Virginia. Groundwater is located at shallow depths and drainage is provided to alleviate seasonal flooding due to heavy precipitation. Even with proper drainage controls, the site is susceptible to flooding from particularly heavy rain events.

As land disturbance will be phased by project, the DOE intends to use controls to maintain water quality and flow quantities during significant rainfall events during construction and long term operation so as to have no more than a minimal impact on or off the site. Note that offsite flow issues in the event of a severe storm can not be totally planned out (see 4.4.4.2). The next two subsections address the situations involving surface water quality and storm water flow.

4.4.4.1 Surface Water Quality Control

On-site surface flow is made up of rainfall, of which a small fraction is from the adjacent City and SURA properties, ongoing structural dewatering effluent, and some cooling tower and tunnel sump discharges. The DOE facility is primarily located in the watershed of Brick Kiln Creek, which discharges to the Big Bethel recreation area and then to the Chesapeake Bay. A small portion of the DOE site flows to the west to Deep Creek and the James River.

An area topographic map is provided as Figure 6. Except for a small area at the existing retention pond, there are no perennial ponds or streams on the site. There are some small, ephemeral streams and storm channels throughout the site and beyond the DOE site boundary. Localized ponds that form during storm events are drained through surface channels and groundwater recharge. Storm water flow management is discussed in Section 4.4.4.2.

In the course of implementing this proposed action, the DOE shall comply with the terms of applicable Federal, State, and local regulations and directives with regard to surface waters, including Virginia's Erosion and Sediment Control Handbook (see below), and the site's storm water management program. The DOE will cooperate with State, regional, and City of Newport News agencies and departments to ensure that surface water quality concerns are given appropriate consideration through all activities described in this EA. DOE will ensure that JSA flows down applicable provisions of Federal and State agency policies and mandates to its subcontractors as required in the DOE/JSA Contract.

- Construction: Expected minor impacts could result from erosion and sedimentation to on-site storm water channels and from increased storm flows with the loss of vegetated ground from land disturbances during on-site construction. Up to 5 acres

would be affected at any one time, for a total of about 13 acres overall. Impacts due to the potential for increased storm flow runoff are discussed in Section 4.4.4.2.

Standard erosion control measures would be implemented prior to and during disturbance of soils to minimize runoff and the potential deposit of sediments in surface waters and include the protection of stockpiled earthen materials. These measures would be identified in the form of either a site-approved or an agency-approved E&SC plan. Each plan will be site specific. For sites greater than 1 acre, the work will be done in conformance with the terms and conditions of the DCR General VPDES Permit for Discharges of Storm Water from Construction Activity. All plans will be approved prior to the disturbance of land associated with a construction project. As E&SC plans will be utilized to minimize any disturbance outside of the immediate construction area, there should be no impacts due to erosion or sediment on adjacent on-site or offsite areas or regions further downstream that may have CBPA designations. No mitigation of impacts from sedimentation is expected to be necessary after construction and area stabilization are complete.

It is anticipated that there will be no herbicides or pesticides, beyond termite controls, used during construction. If products are identified as necessary for a specific problem, the product will be selected so as to minimize toxicity and designated for use only in accordance with manufacturer's instructions.

- Installation, Commissioning, Operation and Maintenance: Water quality factors during day to day operations have been considered. The actions identified in this EA are not expected to influence the quality of waters discharged to the surface or to HRSD any differently from the minimal effects that already occur due to current operations, such as the slightly elevated temperatures in cooling tower effluent.

  A slightly higher quantity of activated water will be generated from the upgrade to CEBAF operations that will affect water at the water-cooled beam dumps at the experimental halls, including the new Hall D complex environs, and at the sumps within the accelerator tunnel. No increase in activity at the water in the FEL facility is anticipated from upgraded activities at the FEL. This small increase in the amount of activated water generated will be managed under current site programs.

  The quality of any cooling tower waters discharged to the surface or to HRSD will be maintained and managed under the same permit conditions already in place; thus no effects on surface water from this expanded activity are expected.

  No additional effects involving water quality at sump discharges in areas outside the tunnel itself are expected.

  Long-term operations to support these new activities should not result in an increase in the use of vehicles on the site, including the impacts from oil usage and exhaust emissions that are collected in rainfall winding up on the surface. The implementation of existing site practices and procedures will ensure that potential contaminants are

properly transported and stored. There are no plans for outside storage of liquids included in this proposed action.

If any herbicides, pesticides, or fertilizers are to be used during normal operations and landscape maintenance, an integrated approach will be used. The herbicide, pesticide, or fertilizer will be selected so as to minimize toxicity and would only be used according to manufacturer's instructions. Usage of toxic materials within the proximity of any storm channel would be prohibited. As a result, very limited impacts from the use of chemicals for pest control and landscape maintenance are expected, as use will be carefully managed, with no such materials being stored on the Jefferson Lab site. There should be no impact from unintentional applications, spills, or runoff to surface waters.

There are no anticipated changes in water quality due to new uses or in dewatering quantities. By using properly implemented E&SC measures, incorporating cooling water discharges into existing permits, using storm water controls noted in Section 4.4.4.2, and strictly minimizing the use of any toxic substances, only minor impacts on the site and no impacts on offsite surface waters are predicted from the construction of additional structures and from new building use and CEBAF and FEL upgraded operations as described in this proposed action.

4.4.4.2 Stormwater Management

Jefferson Lab has three watershed areas. A small portion, approximately 22 acres at the northwest end of the site, drains into the City of Newport News storm system along Jefferson Avenue. No proposed actions are in this watershed area, so is not discussed herein. See Figure 6 for the area topographic map and Figure 7 for the watersheds areas and the sub-basins within each area.

Watershed Area 1 is the larger of the other two watershed areas and contains about 148 acres. The western half of the watershed is almost fully developed while the eastern portion is wooded and open spaces. The topography generally slopes to the southeast and two major open channels in Watershed 1 convey storm water runoff. These two channels merge and the storm water runoff exits the Jefferson Lab site at twin 54-inch culverts under Canon Boulevard. The retention pond constructed in 2005 manages the storm water from the northerly portion of this watershed and was sized for future developments including the proposed actions of the North Connector Parking Lot and the North Connector Road Extension in this EA. The proposed East Retention Pond will manage the southerly portion of this watershed. The two retention ponds for this watershed will ensure that the future developments described in this EA and in the Ten Year Site Plan do not increase the established peak discharge rate at the Canon Boulevard culverts. Prior to the final design of the East Retention Pond, the storm water model will be updated to include the existing retention pond and the planned developments in this EA to ensure storm water flow design goals are met with the East Retention Pond.

Watershed Area 2 is the southwest section of Jefferson Lab's developed area and contains about 55 acres. The storm water runoff is conveyed through open channels and culverts to the center of the watershed area and then south. The outfall for Watershed 2 is through a 48-inch culvert at the Oyster Point Drainage Ditch on the south property line. Watershed Area 2 is more densely

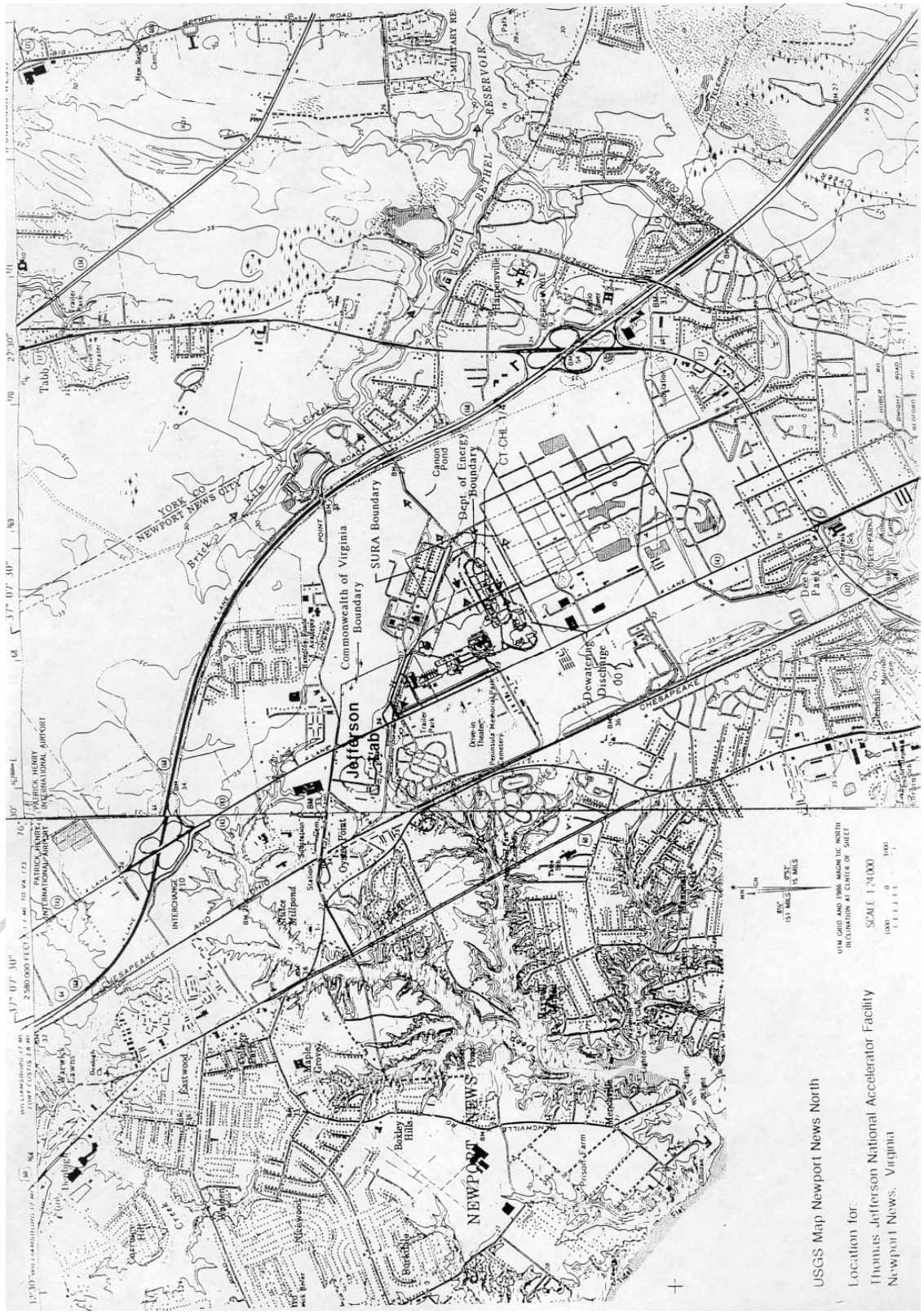
developed than Watershed Area 1 and proposed actions will increase the impervious area by approximately one acre.

Dewatering effluents and other minor point discharges to the surface flow are trivial and do not need to be assessed for impacts.

These two retention ponds will serve multiple purposes. They will manage storm water flow, and as water quality BMPs they will demonstrate both DOE's commitment to address runoff to comply with applicable Federal, State, and local regulations and its agreement to meet the general performance criteria identified in the CBPADMR and the terms and commitments in the VPDES general permits for construction discharges and for ongoing storm water pollution prevention management. There should not be a major impact on the site or on the offsite drainage system due to this proposed action with the addition of these BMPs.

Due to these planned improvements in the storm water control function of the DOE site, no increased flows or flow rates as waters leave the site are expected as a result of this action, so there should be no impacts, CZMA or otherwise, on downstream areas. This is in compliance with the storm water criteria identified in the CBPADMR.

Water quality-related impacts, such as due to the application of herbicides, are to be mitigated as discussed in the previous section.



935 **Figure 6** - Topographic Map

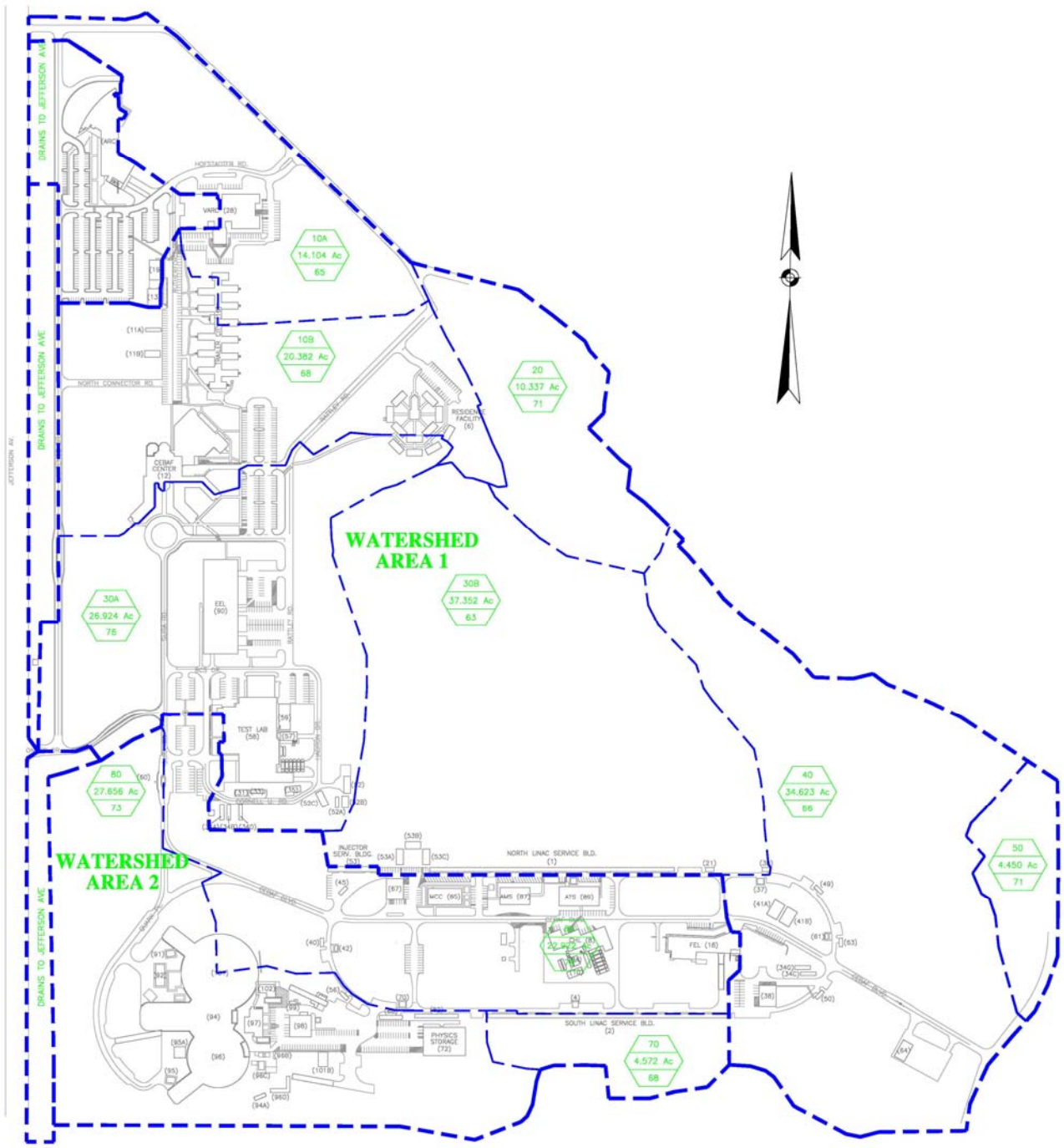


Figure 7 - Jefferson Lab Watershed Areas and Sub-basins

4.4.4.3 Groundwater

The only activities addressed in this EA that could have a potential impact on the site groundwater, except for short construction-related impacts, are those involving activation due to the CEBAF upgrade that includes effects at the existing experiment halls and the new Hall D. Operation of the upgraded FEL is expected to have only a negligible potential impact on groundwater resources.

The 1987 EA described regional and local hydrogeologic conditions and characteristics at the Jefferson Lab site in Newport News, Virginia. To support CEBAF operations, a more recent Hydrogeologic Review[14] and update were done that focused on the portion of the site that is or could be affected by the CEBAF accelerator and the FEL facility located inside the CEBAF accelerator "racetrack". Updated and new information on both geology and local hydrologic patterns, such as groundwater flow, were provided in the two reports. Information on water resources at the Jefferson Lab site derived from this report, unless otherwise noted, is provided in the following paragraphs. In the future, to support the planned CEBAF and FEL upgrades, a new hydrogeologic study will be performed to document the latest groundwater flow regime. This study will review potential effects of CEBAF, FEL, and Hall A, B, C, and D operations and effects from impacts from Accelerator Site construction activities. This hydrogeologic modeling study will be performed to support an update to the Lab's current VPDES Permit No. VA0089320 that will assist the DOE to document the placement of long term groundwater monitoring wells during CEBAF and experimental hall operation. The known groundwater situation follows.

On-site surface water discharges, including the groundwater dewatering effluent, storm water, and sump discharges pass through the on-site and offsite storm drainage channel network. Both main drainage channels leading from Watersheds 1 and 2 (refer to Figure 7) are contiguous with Brick Kiln Creek and the Big Bethel recreation area, which is located approximately one and one half miles downstream and to the east of the Accelerator Site. The Watershed 3 area would not be affected by accelerator operations. Groundwater wells have neither been used in the past nor are they presently used as a source of either municipal (Newport News) drinking water supply or as a private source of drinking water. The permanent groundwater dewatering at the existing experimental halls, as discussed below in Section 4.4.4.3.1, will continue for the life of the facility. These groundwater withdrawal rates at the experiment halls have been fairly constant since the completion of the original Hall A, B and C construction. Average daily discharge values have ranged from about 12,000 to 21,000 gallons (.019 to .032 cfs) and are substantially lower than originally estimated.

Baseline groundwater quality for the Jefferson Lab Accelerator Site has been monitored under the direction of Jefferson Lab's radiation control staff since 1989 using monitoring wells. These initial wells were installed in 1989 in accordance with a Virginia Pollution Abatement (VPA) permit (VPA01001) to provide a pre-construction water quality baseline on the distribution of groundwater constituents. Background data through 1995 were compiled for pH, conductivity, hardness, trace metals, and radionuclides. These data are documented in the VPA permit

[14] Malcolm Pirnie, Inc. 1995. CEBAF Hydrogeologic Review, Newport News, Virginia, September.

modification request and addendum[15]. Monitoring wells have been positioned according to the distance from the CEBAF accelerator tunnel and experimental halls, with A-ring wells being the closest and C-ring wells the farthest from the structure. Refer to Figure 8 for the locations of the monitoring wells.

Measurements at the A, B, and C-ring wells in the current VPDES Permit No. VA0089320 have been taken since 1995 in association with the start of CEBAF operations. Currently, monitoring results at the C-ring wells are compared annually with the baseline water quality levels at the site boundary. In addition, results at the B-ring wells are compared semiannually against permit limits for the wells closer to the Accelerator. Also, the results from the A-ring wells, located closest to the CEBAF enclosure, are compared quarterly against action levels.

Prior to CEBAF operation, naturally occurring radionuclides (indicated by gross beta and gross alpha activity) were shown to be present in varying levels across the site. Since start of CEBAF operations in 1995, radionuclide levels have been below permit-specific sensitivity levels, with the exception of gross beta and gross alpha activity, which are detectable but remain within permit limits. There have been no unexplained variations in non-radiological parameters, with no effects identified that relate to accelerator operations.

Groundwater elevation measurements, taken at the monitoring wells as noted in the VPDES Permit 0089320, have indicated that the site high groundwater elevation has shifted slightly from that described in earlier studies. Groundwater flow is generally to the east, south, and west away from the groundwater high, which is located near an open area east of the Test Lab Building and north of the North Linac Service Building near wells GW-12, GW-13, and GW-14 (see Figure 8). The flow pattern reflects the localized influence of the groundwater dewatering system in the Hall A, B, C vicinity, on the area groundwater flow. Water levels fluctuated during construction, but have since stabilized. Hydraulic conductivities range from 2.7×10^{-5} cm/sec to 1.7×10^{-2} cm/sec, with a geometric mean value of 2.0×10^{-3} cm/sec[16] (groundwater flow velocities site wide are estimated at 30 to 70 feet per year, or 9 to 21 meters per year. Groundwater shielding calculations were based on 2.5 m/yr[17]. The hydraulic conductivities are relatively low across the site, except for one identified area of higher conductivity extending generally northeast to southeast in the experiment hall vicinity. The groundwater velocities are relatively low and have seasonal variations. By learning that the groundwater is moving faster than originally calculated, it became known that there is less potential for it to become activated. The water moves more quickly past the underground accelerator and hall areas, minimizing exposure to potential radiation sources.

[15] Helms, K.D. (DOE Site Office Manager) 1995. VPA permit modification proposal and addendum, letters to Mr. Robert P. Goode, Virginia Department of Environmental Quality, July 5 and November 20.

[16] Malcolm Pirnie, Inc. 2002. Groundwater Flow Direction and Velocities at Jefferson Lab, Newport News, Virginia, February.

[17] Stapleton, G. 1987. "The Production of Radionuclides in the Groundwater," Jefferson Lab Tech Note, TN-0062, Newport News, Virginia.

4.4.4.3.1 Groundwater Withdrawal

Groundwater dewatering equipment at the experiment halls operates on a continuous basis to maintain the groundwater table to prevent flooding of the halls which contain complex electronics and other apparatus. The local groundwater levels have been lowered by several feet and flow patterns have been modified in the vicinity of the experiment halls by this withdrawal. Based on information and data collected, dewatering activities have not affected the water table beyond the site boundaries[14,16]. Dewatering rates at the halls are not expected to change during operation of CEBAF at the proposed levels. Because construction of Experimental Hall D involves excavation and movement of significant portions of earth, temporary dewatering during construction will be required, but no ongoing dewatering is expected. In addition to the hydrogeologic study to be performed to support groundwater monitoring for the CEBAF upgrade (refer to 4.4.4.3), a post construction hydrogeological study will be performed on the Accelerator Site after construction of the Hall D complex. Construction is not expected to affect groundwater flow direction or velocity in a substantial manner. Therefore, any other effects on the water table are unlikely.

Tritium, gross beta activity, and pH of the dewatering effluent are monitored on a quarterly basis under the terms of VPDES Permit No. VA0089320. Results to date are within all permit criteria. Because groundwater activation with the proposed changes is not expected to increase above background levels (see Section 4.4.4.3.2 below), tritium and gross beta activity in the dewatering effluent would not exceed that of the present dewatering discharge, and thus remain below permit limits.

4.4.4.3.2 Activated Groundwater

The accelerators at Jefferson Lab, CEBAF and the FEL, were designed and constructed below ground with careful attention to shield groundwater from prompt radiation due to accelerator operations. In the case of CEBAF and experimental Halls A, B, and C, which are partially buried, prompt radiation is contained in self contained beam dump systems that absorb the radiation. This situation is discussed in the following paragraphs. In the case of the FEL, from the very beginning, it was designed to use energy recovery whereby the energy in the accelerated electron beam is recovered in RF. In this manner, the electron beam energy absorbed by the FEL beam dump is less than 10 MeV, an energy where there is virtually no induced radioactivity caused by the dumped beam. This is the case for the original and upgraded FEL operations and will also apply to this proposed FEL upgrade, and the activity is independent of the power in the circulating electron beam. Thus, not only did the original FEL have negligible impacts on groundwater, the change in operations for the FEL upgrade will also have negligible impacts on groundwater[18].

With regards to CEBAF and experiment hall operation, there is a concern that any induced radioactivity in groundwater could be transported to local surface waters and ultimately to the Big Bethel recreation area located about one and one-half miles east of

[18] Neil, G et al. 1995. "Shielding and Other Radiation Safety Requirements for the 200 MeV Recirculating Linac with Energy Recovery for the UV FEL," CEBAF Tech Note 95-044, Newport News, Virginia.

the DOE Site. The groundwater table on the Accelerator Site is shallow and is influenced by site drainage, especially at the hall area dewatering operation. Because of this potential for activation, Jefferson Lab operates under that VPDES Permit that governs an ongoing groundwater monitoring program that includes the dewatering effluent.

VPDES Permit No. VA0089320 regulates groundwater quality by placing limits on the radioactivity in the groundwater around the accelerator enclosure and its experiment areas, the three halls. The FEL facility is within the area covered under this permit. Areas of special concern are the existing beam dump areas, especially the two HPBDs in Halls A and C, and the beam spreader and beam recombiner areas located at each end of the North and South Linacs (see Figure 2). Quarterly sampling of the 'A' ring wells (nearest to the CEBAF tunnel), semi-annual sampling of the 'B' ring wells (downstream of the A-ring wells), and annual sampling of the 'C' ring wells (downstream of the B-ring wells) and the upgradient well are performed under the permit (see the map on Figure 8). Parameters monitored under this permit are gross beta and the potential accelerator-generated radionuclides: manganese-54 (^{54}Mn), tritium (^{3}H), sodium-22 (^{22}Na), and beryllium-7 (^{7}Be). Non-radiological parameters monitored are pH, conductivity, total suspended solids, and total dissolved solids. Results to date show variations in these constituents with season, location, and construction-related factors. To date, Jefferson Lab has been in compliance with all permit requirements.

Construction of the proposed Hall D complex will impact the monitoring area of at least three existing monitoring wells. New monitoring wells for the Hall D area will need to be installed. Placement of the new wells in the Hall D area and any other identified locations and any proposed permit modifications will be based on information to be obtained from the planned hydrogeologic modeling study. As well, there may be alternate well locations for other existing wells that would be recommended based on the planned modeling.

DOE reported estimates of groundwater activation in the 1987 EA for operation of CEBAF up to a maximum beam energy of 6.0 GeV at 1,200 kW beam power and in the 1997 EA for operation up to a maximum of 8.0 GeV at a maximum 1,000 kW beam power. Operating experience, groundwater testing, and calculations have demonstrated that shielding has functioned adequately for beam energies up to 6.0 GeV at 1,000 kW beam power and is expected to function adequately at energies up to the 8.0 GeV as noted in EA-1204 [7,19].

Table 2 provides the maximum pre-operational concentrations of radionuclides measured in groundwater from December 1990 to December 1995. The measurements taken at the C-ring wells, used to determine operational permit limits, were incorporated into VPDES Permit No. VA0089320 for CEBAF operation as action levels or limits. Since CEBAF began operating in late 1995, radionuclides in groundwater nearest the accelerator enclosure, which has the greatest potential to be affected, have been measured most frequently. Results from all sampling indicate that the predictions made in the 1987 EA

[19] DEQ Permit No. VA0089320 Quarterly Groundwater Reporting Data.

regarding groundwater activation were conservative. All 1996 through 2005 operational concentrations of radionuclides measured in groundwater reported to the Commonwealth of Virginia have been less than permit limitations (Table 3), with one exception. In a sample taken at well GW-20 in the fourth-quarter 1996, the gross beta concentration exceeded the permit limit of 50 pCi/L. The source of the exceedance was investigated, and it was determined that the activity was due to the presence of naturally occurring radionuclides of radium and thorium, which are not accelerator-produced. In reality, therefore, Jefferson Lab has not exceeded its permit limitations during routine operations.

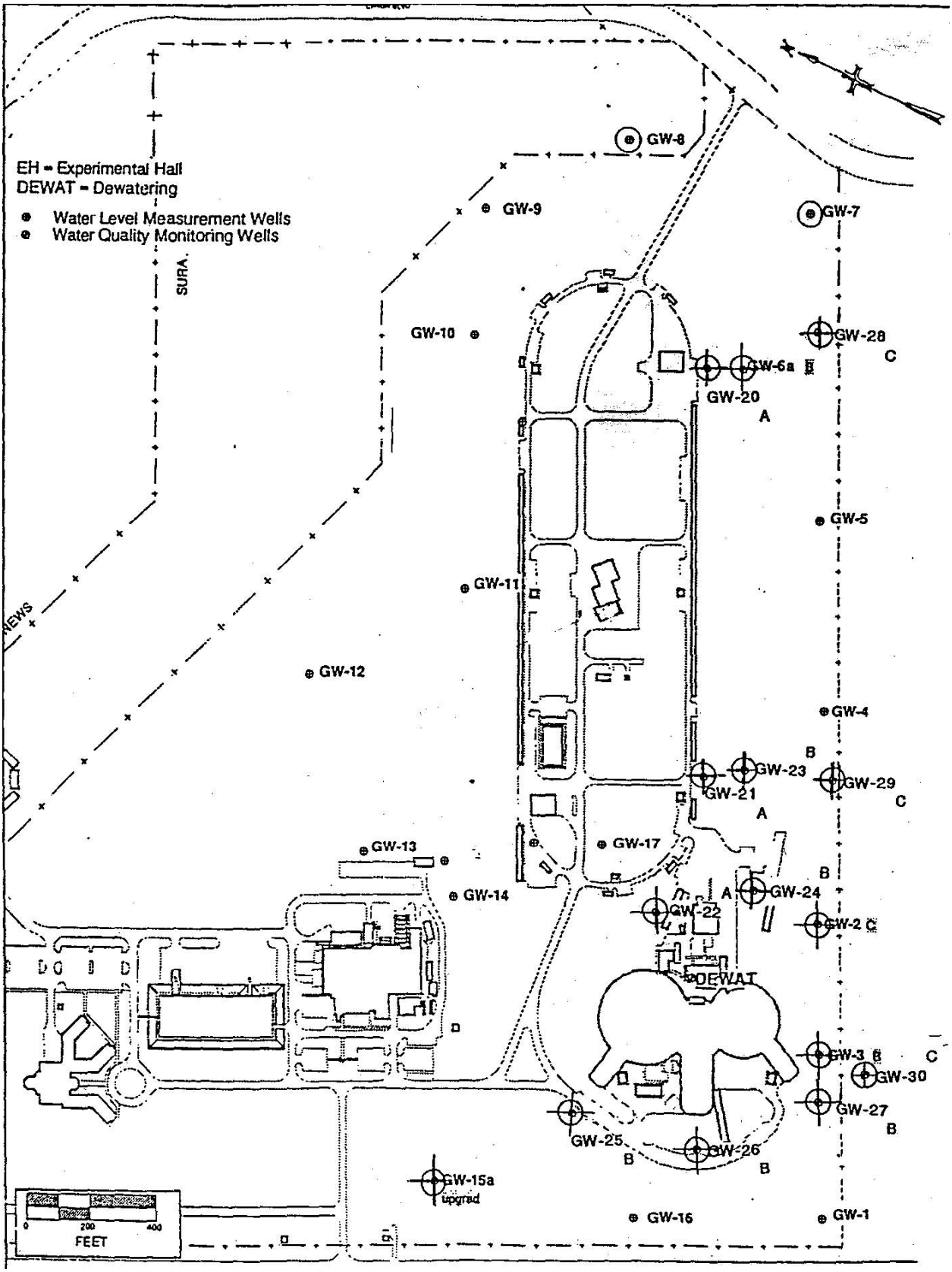


Figure 8 - Monitoring Well Locations

Table 2 - Maximum Pre-operational Concentrations of Radionuclides Measured in Groundwater

December 1990 through December 1995

Analyte	A-ring	B-ring	C-ring[a/c]
Gross beta[b]	<50 pCi/L	<50 pCi/L	<153 pCi/L
Manmade radioactivity[b]	<1 mrem/yr	<1 mrem/yr	—[d]
Tritium	<5000 pCi/L	<5000 pCi/L	<1000 pCi/L
Sodium-22	<40 pCi/L	<40 pCi/L	<61 pCi/L
Beryllium-7	<600 pCi/L	<600 pCi/L	<835 pCi/L
Manganese-54	<30 pCi/L	<30 pCi/L	<51 pCi/L

[a]Incorporated into VPDES permit for CEBAF operation as permit action levels/limits.
[b]May be a result of naturally occurring or accelerator-produced radioactivity.
[c]Numbers are representative of pre-operational radionuclide concentrations plus 2 standard deviations, which represent a 99% certainty that deviations above this level are not random.
[d]Baseline data was collected but no permit or action limits were defined under the VPA permit.

Conversion note: 1 pCi = 0.037 Bq, 1 mrem = 0.01 mSv.

Table 3 - Maximum Concentrations of Radionuclides Measured in Groundwater During CEBAF Operation

January 1996 through December 2005

Analyte[d]	A-ring	B-ring	C-ring
Gross beta[a/c]	72.2 ± 9.69 pCi/L[b]	32.9 ± 2.3 pCi/L	21.84 ± 2.83 pCi/L
Manmade radioactivity[a]	<0.292 mrem/yr	<0.353 mrem/yr	—[e]
Tritium	<1000 pCi/L	<1000 pCi/L	<1000 pCi/L
Sodium-22	<40 pCi/L	<40 pCi/L	<40 pCi/L
Beryllium-7	<600 pCi/L	<600 pCi/L	<600 pCi/L
Manganese-54	<30 pCi/L	<30 pCi/L	<30 pCi/L

[a]May be a result of naturally occurring or accelerator-produced radioactivity.
[b]GW-20 (A-ring) was reanalyzed after removal of solids containing naturally occurring radionuclides with DEQ approval. Sample value after reanalysis was <50 pCi/L.
[c]± represents 2 standard deviations.
[d]Radionuclides are analyzed at Environmental Protection Agency (EPA) sensitivity levels or better where applicable.
[e]No permit limits specified.

Conversion note: 1 pCi = 0.037 Bq, 1 mrem = 0.01 mSv.

Groundwater activation by prompt radiation is directly proportional to the operating electron beam power. With an increase in energy in the CEBAF accelerator from approximately 8.0 GeV to 16.0 GeV, it should be noted that some of the assumed beam losses (beam that strays from the main accelerator beam line) may actually decrease because the intensity of bremsstrahlung radiation peaks in the forward direction may be more "forward peaked" (so effects may be more limited in scope); however, a conservative doubling of losses is used for calculational purposes. As noted from data listed in Table 3, ^{22}Na and ^{3}H have never been detected in samples of any of the

groundwater wells at concentrations above the Minimum Detectable Concentration (MDC). Shielding of the original tunnel and halls to prevent the exceedance of groundwater activation limits was designed using a conservative factor of 4 based on assumed beam losses; thus going from 4.0 to 8.0 and then 16.0 GeV is still addressed by the original shielding design. Groundwater well monitoring data having never indicated groundwater activation for ^{3}H and ^{22}Na provides evidence that the current shielding is appropriate. Because the groundwater activation is directly proportional to power of beam lost, a doubling of the CEBAF operational beam power limit from 1 MW to 2 MW would still result in a factor of 2 conservatism in groundwater shielding for the CEBAF proper. Again, this is assuming twice the beam loss that was designed for, which is unlikely due to the increased "forward peaking" of the accelerator beam at higher beam energy, and the accumulated operational history and expertise of the accelerator[20].

In the case of the HPBDs in Halls A and C, which under this EA will only be exposed to a maximum beam power of 1 MW, the groundwater shielding was based on an assumed operational factor of 400 kW and 50% operation which translated into 12.6×10^{12} Joules/year. As can be seen in Table 4, in recent years, the highest total of energy deposited in the HPBDs in a given calendar year is almost a factor of 4 below the design criteria for the HPBD shielding. If this number were doubled (as a result of doubling the operational beam power limit), the HPBD shielding would still be solidly within the original design criteria. Additionally, as delineated in previous calculations, radionuclide concentration buildup is directly related to the length of time a given amount of water is exposed to a neutron flux (e.g. as a result of electron beam loss). Groundwater studies[14,16] indicate that the combination of groundwater flow and end station surface water dewatering pumping work synergistically to produce rapid water flow in the area adjacent to the HPBDs such that even with marginal shielding against activation, it would be exceedingly difficult to exceed permit radionuclide concentration level restrictions in the local groundwater.

[20] Stapleton, G. 1989. "Design of Shielding to Ensure Maximum Concentrations of H-3 and Na-22 in the Groundwater Remain Within Standards," Jefferson Lab Tech Note TN-0155, Newport News, Virginia.

Table 4 - Annual Totals of Beam Energy Deposited in Hall A and Hall C High Power Beam Dumps

Calendar Year	Hall Dump Total (J/year)	Site Total (J/year)
2002	Hall A: 1.55×10^{12}	1.63×10^{12}
	Hall C: 0.08×10^{12}	
2003	Hall A: 0.20×10^{12}	1.32×10^{12}
	Hall C: 1.12×10^{12}	
2004	Hall A: 1.06×10^{12}	3.41×10^{12}
	Hall C: 2.55×10^{12}	
2005 (First Half)	Hall A: 0.58×10^{12}	0.70×10^{12}
	Hall C: 0.12×10^{12}	
Design Goal		12.6×10^{12}

J = joules

The addition of operations at Hall D will have little effect on groundwater activation, as this is a low current experiment hall similar to experimental Hall B. The existing shielding in the tunnel extension leading to Hall D, as well as proposed shielding at the new Hall and local beam dumps, will sufficiently address groundwater activation concerns as shielding will be installed in accordance with established Jefferson Lab beam containment policy.

The FEL upgrade to 200 MeV and 10 mA (milliampere) does not represent an increase in potential to cause radioactivation in the groundwater. This is because the FEL operates in an energy recovery mode, whereby the terminal energy at the beam energy dissipater (dump) is still 10 MeV. This is below the activation threshold for the production of neutrons capable of radioactivating the cooling water in the beam energy dissipater, the beam energy dissipater itself or its shielding, or in the local groundwater. Additionally, because of the operational history with operating the FEL in the energy recovery mode, high current operations in the "straight ahead" mode will be unnecessary, and consequently, this is a negligible groundwater activation concern. Additionally, if this "straight ahead" mode of operation becomes necessary, additional localized shielding will prevent groundwater activation.

Thus for CEBAF, despite a potential doubling of electron beam power, there would be no effective increase in groundwater activation products anticipated. For the FEL, the terminal energy is still below the threshold necessary to produce radioactivated groundwater. Thus a net change in the quantity of groundwater activation products due to the operations at Jefferson Lab either for CEBAF or for the FEL is not anticipated.

4.4.4.4 Radioactivated Wastewater

Sources of radioactivated wastewater that could be affected by the proposed CEBAF upgrade include the experiment halls' air conditioning systems (dehumidification condensate), LCW cooling system (collected residuals, both of which are collected in the floor drain sump pit in Building 97), and the water within the beam energy dissipater [HPBD] cooling water systems (periodic releases) that are contained in Buildings 91, 92, and 95. These activated water sources are routinely monitored and discharged in accordance with the site's sewage treatment system permit [HRSD][21].

The HRSD permit requires that these wastewaters, which may contain radioactivity, must be sampled, analyzed, and tracked as it is discharged to the sewer system. Samples are taken at locations and frequencies specified in the HRSD permit and reported to HRSD on a monthly and quarterly basis. The HRSD permit limitations include: pH at or above 5.0, up to 5 Ci (curies) total activity per calendar year for ^{3}H, and up to 1 Ci per calendar year total activity for any other gamma-emitting radionuclides. Results to date have shown no exceedances of HRSD permit limitations with the exception of a ^{3}H contaminated gas release in Hall C in 1998. Strict administrative requirements make a repeat of that scenario highly unlikely.

A doubling of accelerator beam power in the tunnel, with the halls limited to receiving no greater than the current beam power, is unlikely to substantially change the quantity generated or the way in which radioactivated wastewater is managed and removed from the site. Quantities of ^{3}H removed in the past 10 years, as shown in Table 5, have hovered in the neighborhood of 1.0 Ci disposed of through the HRSD sanitary sewage system per year. As water activation is approximately proportional to beam power deposited in the HPBDs, a doubling of the power in the tunnel would increase annual activated water discharges to approximately 2.0 to 3.0 Ci. As a worst case scenario, if radionuclide concentrations exceeded HRSD permit limitations, the entire water system could be pumped down, and disposed at an appropriate radioactive waste disposal facility.

[21] Johnson, R. E. (Chief of Industrial Waste, Hampton Roads Sanitation District) 2006. Letter to James A. Turi, DOE Site Manager, April 21, 2006, revising Hampton Roads Sanitation District Industrial Wastewater Discharge Permit No. 0117, effective March 1, 2002 to March 1, 2007.

Table 5 - Cumulative Annual Quantities of Tritium Disposed through HRSD

Calendar Year	Discharged Tritium (Ci)
2005	1.14
2004	0.90
2003	0.94
2002	1.0

Because of the low current accelerator beam delivery to Hall D, and a beam dump design similar to that in the Beam Switchyard, Hall D will not contribute more than a minimal amount of activated wastewater to be managed under the site program.

The FEL typically operates in an "energy recovery" mode, which minimizes the amount of radioactived wastewater produced in its beam energy dissipaters (dumps). The FEL can also operate in the "straight ahead" mode for diagnostic purposes or for fixed target irradiation. When in the "straight-ahead" mode, the FEL produces radioactivated water in the beam energy dissipater. The FEL is rarely operated in this manner and the water is recirculated in a closed loop cooling system. This wastewater may eventually be released in accordance with the HRSD Permit if maintenance on this system is required. However, there have been no routine releases of radioactivated wastewater from the FEL to date. Sources of radioactive wastewater are expected to increase negligibly with FEL accelerator operation under the proposed parameters.

Discharges to the public sewer system would continue in accordance with the HRSD Permit, and all parameters, including total discharged in a calendar year, would remain within the HRSD permit limits. Because of this, no additional impacts from any increased generation of activated water are projected for operation of the upgraded CEBAF or FEL including their experimental areas.

4.4.5 Geology and Soils

The Jefferson Lab site is located in the Coastal Plain of the lower York-James Peninsula in an area of low seismic risk as noted in the 1987 EA. The site geology and hydrogeology were thoroughly reviewed in 1995 to support a new Commonwealth of Virginia permit[8,14]. Seismic codes changed in 2000 and a geotechnical review will be performed to support the construction of Hall D. A review of groundwater flow directions and velocities was performed in 2002 and estimates of local hydrogeologic properties were again calculated.

As provided in the 1987 EA, the site is located on the Huntington Flat, which is very flat and poorly drained. Since 1987, overall site and area drainage has changed, in that there is less open ground to absorb flow, as nearby offsite commercial and industrial development has progressed. Site elevations range from roughly 29 to 35 feet above MSL. The surface soil is underlain by the clayey-sand and sand facies of the Yorktown Formation (Chesapeake Group) and overlying Columbia Group, which is comprised of four formations. These formations are similar to many

Quarternary formations that comprise the riverine, estuarine, and coastal terraces of the Virginia Coastal Plain.

The soil types in the areas to be disturbed are: Chickahominy silt loam, Slagle fine sandy loam, and Udorthents-Dumps Complex. The soil types across the site seemed fairly similar, with most meeting the criteria for hydric soils. The new buildings will be designed as best suits the local soil types. As minimal activity below the surface will occur under this proposed action, there should be only minor construction-related impacts and no impacts from operations. BMPs will be implemented and no geology or soil related mitigations are necessary.

4.4.6 Monitoring and Mitigation

4.4.6.1 Existing Environment and Potential Environmental Impacts

Jefferson Lab uses environmental monitoring to assess local and offsite environmental conditions. The site environmental monitoring program verifies that any radiation exposures, and radioactive and non-radioactive effluent releases, comply with applicable regulations and other requirements.

While radiation and dose rates offsite, from direct and airborne radioactivity, are expected to be well below limits set for the general public, monitoring ensures that the established controls are effective. Jefferson Lab operations have minimal radiological dose impact to the public and the environment. Lab programs and outside advisory committees ensure that the Lab continues to function within regulatory and established administrative limits for direct radiation and airborne emissions. To date, there have been no offsite releases of radioactivity in any water effluents beyond the small quantities allowed to be discharged under our HRSD permit. Construction and upgrades of the facilities in question are not expected to increase radioactive airborne emissions or water effluents beyond current and historic levels.

4.4.6.2 Air

Airborne radionuclide concentrations at the site boundary have been too low to accurately measure. Annual calculations, using EPA-approved computer modeling codes, have indicated that Jefferson Lab operational emissions remain several orders of magnitude lower than the EPA 10 millirem/year (mrem/yr) reporting limit.

4.4.6.3 Water

4.4.6.3.1 Groundwater

Activation of groundwater, as a result of direct or secondary radiation, is possible in certain locations around the accelerator complex. Massive concrete and steel shields within the accelerator beam enclosures and in the beam deceleration areas minimize groundwater activation. The monitoring conditions in VPDES Permit No. VA0089320 serve as the basis for evaluating accelerator-produced radioactivity in groundwater. This VPDES groundwater quality permit specifies EPA-approved sampling and analysis protocols. (The water quality beyond the Lab boundary must remain well below the regulated drinking water limit of 1 mrem/year.)

4.4.6.3.2 Surface Water

Surface water quality is maintained by discharging only unpolluted waters, such as rainwater and groundwater, to the environment. Potential sources of contamination to surface waters and associated control measures include:

- Using proper procedures, such as secondary containment, to prevent releases of environmentally harmful materials (EHMs) to surface water or the ground.
- Preventing potential oil leaks from equipment or system malfunctions as addressed in the SPCC Plan.
- The addition of sediments and other pollutants to surface waters from pumping at construction areas is addressed by including specific contractual requirements for any subcontractor performing earthwork to follow the practices identified in the Virginia Erosion and Sediment Control Handbook.
- Water within the tunnels and experimental halls may become activated from exposure to radiation. The Radiation Control Department (RadCon) procedures that address activated water management provide for sampling and monitoring of water (before release) from any potential source within the accelerator and experimental halls.

4.4.6.4 Other Water Monitoring

The Cooling Water Tank (Building 92) and the floor drain sump (FDS) pit (Building 97) are considered one HRSD sampling point. The FDS pit collects various discharges, including low-level activated dehumidification condensate from air conditioning systems located in the experimental halls, while the Cooling Water Tank contains activated water from various accelerator apparatus. Sampling and analysis for tritium are performed prior to any discharges to the sanitary system. The results are recorded, and monthly and quarterly concentration values are provided to HRSD.

4.4.7 Non-Radiological Air Quality

4.4.7.1 Non-Radiological Air Quality during Construction

During construction, the operation of construction equipment and subcontractor vehicles onsite would produce non-radiological emissions common to similar activities elsewhere (hydrocarbons, sulfur dioxide, carbon monoxide, etc.). Emissions are derived mainly from project related transportation vehicles, dust generated from clearing, grading, excavating, and travel on unpaved roadways, and combustion emissions from heavy duty construction equipment. Emissions would occur throughout the course of each construction activity and would be localized near each construction site. Up to 5 acres would be affected by construction at any one time; therefore, these emissions are anticipated to be small and no noticeable offsite effects are expected. Because the project site is within an ozone maintenance area, precautionary measures will be employed during construction to reduce ground level ozone concentrations, especially during ozone alert days. In the event an ozone alert is issued during vehicle-intensive construction activities, vehicles that are not being actively used will be removed from service and turned off. Haul routes will be designated to keep construction traffic moving. Measures to

accomplish this would include the design of access roads and intersections to avoid or minimize traffic congestion. As part of the spill prevention program, fuel containers will be tightly sealed, which will help minimize ozone generation. Other measures during construction would include the use of low volatile organic compound (VOC) coatings and products to the maximum extent practical in accordance with sustainable design principles. There is minimal to no anticipated use of pesticides or herbicides during construction, so there should be no impact to air quality from that type of activity.

Control methods identified in applicable regulations would be implemented to minimize fugitive dust resulting from construction activities. The methods, that include the use of water for dust control and the covering of open equipment when conveying materials, will be included in the construction specifications for each project. There are no concerns involving open burning, as there will be no open burning of debris. All waste materials will be disposed of in the most resource efficient manner. BMPs, including optimizing vehicular use as practicable, will be implemented to minimize impacts.

As the project site is within an ozone maintenance area, measures to minimize the generation of pollutants will be incorporated into the designs as practical. No refrigeration equipment that uses ozone-depleting substances will be used in any of the new buildings. The parking lot and access road layouts to serve these structures would be designed to minimize idling vehicles to the extent practical. The application of herbicides, pesticides, and fertilizers will be managed under an integrated program that minimizes the use of toxic materials, including VOCs, so effects on air quality would be minimal.

Therefore, contribution from the proposed action to offsite concentrations of regulated non-radiological air pollutants would be kept to a minimum. No mitigations beyond using BMPs to both optimize operations and minimize equipment use are necessary.

4.4.7.2 Non-Radiological Air – Installation, Commissioning, Operations & Maintenance

- CEBAF – During operations, effluent sources would include natural gas combustion exhaust, restroom exhaust, kitchen exhaust, and sewer vent exhaust. Chemical operations are limited to small quantity use of solvents, so emissions are negligible. Ozone levels are minimized because the beam travels in a vacuum. Ozone emissions only occur when there is substantial vacuum degradation. Such degradation would cause the accelerator to go down, so ozone emissions are negligible.

- CHL – Operation of cooling towers would result in water vapor emissions but are not anticipated to be detectable offsite. Fog from the towers and in the immediate vicinity of a tower may be present on clear days. The cooling towers will be similar in size and design to existing cooling towers; therefore, little to no impact is anticipated. Dissolved solids contained in the cooling water will be emitted as drift from cooling towers under high heat load but we anticipate the carryover solids will be undetectable above background levels of naturally occurring salts.

- Halls A, B, C, and D – Operation of cooling towers would result in water vapor emissions and associated impacts are discussed in the previous paragraph. One natural

gas generator would service all of the end station areas (the halls and the Counting House). Exhaust from these generators would be intermittent and would not produce important impacts to air quality.

- FEL - The only non-radiological releases to the atmosphere associated with the FEL will be standard industrial air usage (Nitrogen ~80%, Oxygen ~15%), and carbon-based gasses, [(primarily methane (CH6) at approximatly 5%), a combustible, to be maintained considerably above ambient temperatures].

- Associated Buildings - Operation of cooling towers will result in water vapor emissions and the associated impacts discussed above. In the event that an extended ozone alert is issued during regular building operations, Lab Management could choose to stagger working hours to minimize traffic congestion upon entering and leaving the site. Any chemicals kept outdoors should already be sealed so extra precautions would not be necessary. Also, no applications of herbicides, pesticides, or fertilizers would be authorized or performed in the event of an ozone alert.

4.4.8 Noise

Background noise monitoring was conducted in January 2006 for the site. Noise levels around the boundary of the site on Jefferson Avenue average 80 dBA, due to traffic. Canon Boulevard site boundary levels average 78 dBA. Noise is generated by the traffic flow along adjacent streets, by ongoing construction activities on and off the site, by the nearby CSX Railroad, and from activity at the Newport News/Williamsburg International Airport and Langley Air Force Base.

Further measurements were taken in 2006 at a trailer park located approximately 0.3 miles from the site. Noise levels averaged 65 dBA at this location.

Given the industrial nature of the site and its vicinity, noise from construction would not be unique. Construction activities, to be separated by structure and phase, would be spread over a number of years. The construction tasks would range from short to long-term, though all noise concerns would be localized at the Jefferson Lab site. While regular noise from construction equipment and traffic would be highly perceptible locally and less perceptible in nearby offsite areas, no adverse effects on human hearing would occur. No mitigations beyond the implementation of BMPs are identified.

Operating equipment in the proposed buildings would produce various levels of noise. Localized internal building noise levels in the CHL building addition, North and South Access building additions, and two service buildings at the Hall D complex are expected to exceed Occupational Safety and Health Administration (OSHA) limits of 85 dBA. Equipment and building envelope design would be selected to minimize these impacts and no impact to the environment is expected. Operation of the existing exterior cooling towers produces elevated noise levels. January 2006 noise monitoring of cooling towers is shown in Table 6:

Table 6 - Cooling Tower Noise dBA Readings

Cooling Tower	10 feet	20 feet
East Arc	95	92
Building 102	68	66
Building 92	77	75
Test Lab (3)	78	74
CTF (Cryogenic Test Facility)	85	73

Note: The cooling towers not in service were those at the North and South Access Buildings.

The locations of the proposed cooling towers are not adjacent to occupied buildings nor the perimeter of the Jefferson Lab site. Therefore, little to no noise impact is anticipated.

4.4.9 Transportation and Traffic

Jefferson Lab is situated in the middle of a busy industrial and commercial area. The effect of the local traffic on both public and site roads from the additional personal vehicles and trucks during the proposed construction activities will be barely noticeable. There will be minor offsite traffic impacts due to the proposed construction activity. To facilitate entries and exits to the site, and to take into consideration on-site staff, special construction routing and parking needs will be evaluated for each activity. The impacts to staff will be minimized through coordinated planning and by providing advance notification of alternate routing and parking arrangements. Only minimal impacts on-site should result with little to no impacts expected offsite.

As there will be only small changes in staffing and only minimal changes in the present level of transporting goods and services at the site over the next ten years, no impacts involving site traffic and transportation during building operation and use would be expected as a result of this proposed action.

4.4.10 Pollution Prevention

Pollution prevention, as accomplished through source reduction, energy efficiency, waste minimization, and EPP principles and practices, will be emphasized at all stages of this proposed action. The DOE EPP places considerable importance on applying integrated safety and environmental management principles in planning, construction, and regular facility operations. The facility is committed to continually improving its performance with respect to environmental protection.

The proper application of P2 BMPs will result in major resource savings and will mitigate a moderate to high impact if compared to the cost to the environment if these measures and efficiencies are not incorporated.

4.4.10.1 Resource Use Reduction

Factors to reduce the use of natural resources will be considered starting with the planning phase of all activities. These factors include items such as incorporating drought tolerant plants and other beneficial landscaping practices to minimize water usage, and improving the Lab's performance with regards to EPP. As well as procuring materials with recycled content, EPP

refers to further reducing the Lab's need for toxic materials and to choosing products that take into account environmental sustainability.

4.4.10.2 Energy Efficiency

Building scopes will include applicable factors to make the buildings as energy and resource efficient as practicable. New structures that will have regular occupancy will have individual lighting and temperature controls and staff will be trained to make the best use of these features.

4.4.10.3 Waste Management

- Construction - During construction, waste, including all recyclable materials, resulting from construction activities would be managed through each project construction subcontractor using existing site programs that are in adherence with applicable laws and regulations. Construction subcontractors are familiar with the materials and techniques that would best accomplish waste management; it is expected that they will use BMPs to utilize materials with recycled content and to minimize waste generation.

  No special provisions for disposing of activated soil would be necessary and none for the handling and disposal of contaminated soil would be expected. However, if concerns are identified, all materials will be handled and disposed per regulatory requirements.

  Construction specifications would designate the applicable laws and regulations appropriate for the type of wastes involved.

- Operations and Use - Management would continue to support and encourage efficient waste minimization and recycling practices as items are fabricated and as the new buildings and equipment are put into use. Recycling centers would be established in each of the buildings where practical. These practices would help to minimize the low to moderate impacts that result from performing any waste management activities.

- Decommissioning Actions - Items to be removed and replaced from the existing CEBAF and FEL machines and support equipment would be handled per current site programs to minimize waste generation. These programs include reusing elsewhere onsite, storing for later reuse, recycling, excessing through the Federal government system, and, as a last resort, disposing as waste per regulatory requirements.

4.4.11 Land Use

The overall Jefferson Lab site still remains a temporarily wet, upland area but only portions of the site retain the hardwood-pine forest that extended over the site in an earlier time. The site is within an area that the City of Newport News has zoned for research and development. The surrounding Oyster Point area supports a mix of commercial, medium to heavy industrial and limited residential development.

Proposed construction and use activities of the projects within the fenced Accelerator Site would not change the Accelerator Site's industrial nature. Storm drainage and other minor impacts will be mitigated as described or as otherwise appropriate. All impacts, including those from construction, upgraded CEBAF and FEL operation, and from long-term area functioning, will be mitigated using BMPs. All identified mitigations would be fully addressed in the construction project scopes. Prior to undertaking any action that could require mitigation, the DOE will validate that the mitigation actions described in the project scopes have been fully addressed.

4.4.12 Ecological Resources

4.4.12.1 Ecology

In accordance with Endangered Species Act requirements, DOE formally requested written comments regarding the proposed action from the U.S. Fish and Wildlife Service. Contact was also made with the Commonwealth of Virginia DEQ, the Virginia Department of Game and Inland Fisheries (VADGIF), the Virginia Department of Agriculture and Consumer Services' Office of Plant and Pest Services, the VADHR, the Commonwealth of Virginia Department of Conservation and Recreation, Division of Natural Heritage (VADCRDNH), and the City of Newport News Department of Planning and Development for comment on the proposed actions. Additional telephone conversations were held with some of these agencies to clarify provided information. All agencies generally reported that no adverse impacts to protected species and/or habitat would be expected from the proposed action (see Appendix B). All listed species were reviewed during the preparation of this EA. Included was a review of the potential effects on three state-sensitive terrestrial species as requested by the VADGIF.

The VADGIF species of concern that were to be evaluated and coordinated with the VADGIF are the state endangered canebrake rattlesnake, the striped bass, and a local water bird colony containing great egrets and great blue herons. The potential impacts involving them are evaluated in 4.4.12.3 below. The VADCRDNH had also requested that three rare plant species be included in this review. Refer to Sections 4.4.12.3 for a discussion that includes the results from the 2001 review.

4.4.12.2 Terrestrial Resources

4.4.12.2. Vegetation

The portions of the Jefferson Lab site that will be disturbed by this proposed action are located in, or are directly adjacent to, previously developed areas. The proposed areas are described in Section 2.0 and shown on Figure 2.

The VADCRDNH identified three rare plant species of concern for the review performed under DOE/EA-1384. The species considered in that and this EA are: Cuthbert turtlehead, Hazel dodder, and St. John's wort. The Wetland Delineation and Threatened and Endangered Species Survey addressed them in the report. Upon completion of the site-wide field investigations for species and habitat, which were performed in the spring of 2001 and again when the plants would most likely be in flower, the report concluded that there were no sitings of either the plants or any preferred habitats for any of the three species. In the course of the review, the survey crew also checked the site for other special species. It was documented that there were

no resident threatened, endangered, or rare plant species identified on the subject property during any of the field surveys.

As conditions from 2001 have not varied beyond further land disturbance on the DOE site and in adjacent areas, it is concluded that there will be no disturbance of any special concern species or habitat with the approval of this proposed action. Note that the Department of Agriculture and Consumer Services' Office of Plant and Pest Services has reviewed the activity and anticipates no adverse impacts from this project. No mitigations, beyond minimizing the areas of disturbance, are necessary.

4.4.12.2.2 Trees

Though this action will not have an important effect on Virginia forestlands, as identified in correspondence dated November 30, 2001, necessary measures will be taken to protect trees in the vicinity of the construction areas. Specific requirements will be incorporated into the construction specifications and coordinated in the field by the authorized facility representative.

Trees within the construction limits that are earmarked to remain and trees situated on the perimeter of the construction areas will be visibly marked and fenced. The fencing should extend to at least the tree drip line or to the end of the root system, whichever is farthest from the tree. These fenced areas will be maintained as off limits to all activities, including vehicular traffic, parking, equipment staging, or soil stockpiling in order to minimize soil compaction in the vicinity of the trees. If parking or stacking of equipment is deemed unavoidable, that is performing them elsewhere would have a greater adverse consequence, then the subcontractor would be required to use temporary crossing bridges or mats to minimize compaction and any resulting injury to plants. Refer to Section 4.4.3.2 for information on erosion control.

4.4.12.2.3 Fauna

The 1987 EA cited that 257 species of terrestrial vertebrate fauna had geographic ranges that encompassed the site, though only a fraction would be expected to actually exist on the site. The continuing expansion of development, both on the Jefferson Lab site and in all adjacent areas and beyond, has further reduced wildlife habitat and wildlife populations, so the chances of having an on-site existence of many species has grown even smaller. Information on the fauna of concern to the VADGIF is provided in the next section.

4.4.12.3 Threatened and Endangered Species

No threatened or endangered species or suitable habitats for any of the species were identified on-site in the most recent Wetland Delineation and Threatened and Endangered Species Survey. Several surveys of the complete Jefferson Lab site have been conducted over the history of the facility, including the one performed for the 1987 EA and the recent Wetland Delineation and Threatened and Endangered Species Survey. Most of the new information noted is from this most recent (2001) survey. The survey states that there were also no state-listed species or listed rare plants observed and that there were no suitable habitats or conditions for them anywhere on

the Jefferson Lab site property. The specific VADGIF and VADCRDNH species of concern are addressed below.

Agency correspondence received in response to the DOE/EA-1384 review noted that the federal and state-listed threatened bald eagle was identified as the only federally protected species possible at this site. State-listed species present in the project area could include the threatened peregrine falcon and the endangered canebrake rattlesnake. Other rare animals that could be in the Jefferson Lab vicinity, as indicated by the VADGIF, are the special concern species: yellow-crowned night heron, least tern, great egret, great blue heron, and the striped bass. All species were considered in the 2001 survey noted above. The striped bass is discussed in Section 4.4.12.4 and all other state identified species, including rare plants, are addressed next.

The most recent investigation identified no resident threatened or endangered species on the Jefferson Lab site. No other state or federal agencies contacted at the time of this investigation had indicated the possible presence of any threatened, endangered, or otherwise protected species on the DOE site. Area development has minimized or eliminated any possible local habitats. As well, the recent survey found no rare or special-concern species on the site. They, as well as the threatened and endangered species, may appear only as transients as there are no suitable foraging or nesting habitats in existence on the site. The discussion of VADGIF-identified species follows.

The canebrake rattlesnake, a state-endangered species, could be present in the general area. The most recent survey noted that there have been no area canebrake rattlesnake sightings in recent years. This survey included checking for the presence and/or likely habitats for the rattlesnake. None were noted during the review, which paid special attention to this species. It was noted that it is a secretive species that could be overlooked, but the review cited that it is usually present in unfragmented areas, and any likely habitat on Jefferson Lab property and in the surrounding area is very fragmented, so the likelihood of finding one anywhere in the local area is very low. As most of the construction projects will be limited to areas that are already developed or just adjacent to developed areas, it is unlikely that any canebrake rattlesnake habitat will be disturbed. The larger undeveloped areas to be disturbed will be given special attention in that all staff and subcontractors involved in construction activities will be informed about the potential presence of the canebrake rattlesnake or other endangered species, not to disturb or interfere if encountered, to stop all work in the vicinity (at a minimum of 50' from the sighting), and to promptly report it to their Jefferson Lab contact. If a canebrake rattlesnake is observed anywhere on-site, Jefferson Lab will promptly notify the VADGIF's designated contact.

The VADGIF continues to be interested in the effect of disturbance on one local water bird colony that includes great egrets and great blue herons. The colony is located at or near the Big Bethel recreation area, less than two miles from the site boundary. The 2001 REMSA, Inc. report identified no suitable habitat for these species on the Jefferson Lab site. The report also noted that there was no evidence of the use of any site area by great egrets or great blue herons. As the disturbance for this proposed action will be limited to the local construction areas on DOE property and proper controls will be included to prevent any disturbance outside of the construction limits, no impacts on any downstream water bird colonies are expected. No yellow crowned night herons or least terns nor any appropriate habitats were observed on the Jefferson

Lab site during the course of the 2001 survey. No impacts to any individual birds or breeding colonies would occur under this proposed action.

There are no federally protected plants in the project area; however, the VADCRDNH identified Cuthbert turtlehead, hazel dodder, and St. John's wort as rare plant species that could be present in the City of Newport News. These plants were taken into consideration in the 2001 survey that included at least one field trip during the predicted blooming time in August. None of these plants were identified in the proposed areas to be disturbed. Therefore, no on-site or offsite impacts to any of these identified plants are expected under this action.

This EA finds that there should be little to no potential for adverse impact to any of the listed species from either construction disturbance or long-term facility operation. As construction disturbance will be limited to within very local construction areas and be properly managed, so no downstream areas containing these species should be affected. As there are no expected impacts on any of these species, no mitigation actions beyond minimizing disturbed areas are believed necessary. As well, there should be no CZMA impacts on any coastal wildlife, plants, or habitats.

4.4.12.4 Aquatic Resources

There are no permanent aquatic habitats on the site. There are small drainage channels that move water across and off the site, with a few channels just beyond the DOE site limits. The few channels that almost always contain water pass under Canon Boulevard to eventually flow into Brick Kiln Creek. Brick Kiln Creek flows to the closest important body of water, the Big Bethel recreation area, located approximately 2.7 km (1.7 miles) east-southeast from the site.

The VADGIF has identified striped bass as a species of concern in our general area. The most recent survey[13] identified that no habitat for striped bass exists on the Jefferson Lab property. The recently added "modified dry" retention pond is not a suitable environment for such species as it does not connect to any area where striped bass may be present and the quantity of water for fish life is limited. Striped bass exist in tributaries well downstream of the site. The only known location for striped bass is at Lake Maury, which is located roughly 2.4 km (1.5 miles) south-southwest of the site. As the property does not drain in that direction, and as our impacts for this proposed action would be limited to, at most, the property limits, there should be no effect on that particular habitat or on any downstream population of striped bass.

There should be no impact to any downstream aquatic resources from the proposed action, as only minimal pollutants, such as dust, should penetrate past the local construction areas.

4.4.12.5 Floodplain and Wetlands

The Jefferson Lab property, at an average elevation of about 32 feet above MSL and with no permanent streams, is in a Zone C area on the local flood maps, so is not considered a floodplain. Most of the Oyster Point area is in this class. As localized flooding due to large rainfall events is possible, the DOE is addressing storm flow management to minimize any local area impacts. Short and long-term storm water management concerns and solutions will be worked out with local and regional agencies as discussed in Sections 4.4.3.1 and 4.4.3.2. Hence, no higher risk floodplains should be directly or indirectly affected by the proposed action.

The site was originally primarily forested temporary wetlands (1987 EA). The U.S. Army Corps of Engineers approved the site development for the original project. Since then, the site was resurveyed for wetlands according to the U.S. Army Corps of Engineers criteria. None of the proposed construction sites meet the criteria for wetlands.

4.5 HEALTH AND SAFETY IMPACTS

The expected level of impact regarding health and safety concerns for each of the identified activities has been evaluated for this proposed action. The safety and health impacts to workers and the public due to radiological activity resulting from CEBAF and FEL upgrade operations are very low and are discussed in Section 4.5.1. The impacts on subcontractor staff, lab workers, and the public due to construction do not exceed normal levels and are discussed in Section 4.5.3. Other impacts during normal use of the new buildings are evaluated in Section 4.5.4.

4.5.1 Radiological Effects

4.5.1.1 Radiological Background

Humans are exposed to natural background radiological sources in the form of radionuclides present since the formation of the earth (e.g. uranium, thorium, and their decay products) and radionuclides created by solar and cosmic rays (e.g., ^{3}H, ^{7}Be, ^{14}C, ^{22}Na). Humans are also exposed to the same solar and cosmic rays. The estimated total effective dose equivalent for a typical resident in the United States from natural background radiation is about 300 mrem/yr[22]. For comparison, the average annual contributions from cosmic and solar rays and the natural background radiological sources mentioned above are 30 mrem and 230 mrem, respectively. These, added to the internal dose of 40 mrem from foodstuffs containing background radionuclide sources, yield a dose of 300 mrem for the average resident of the United States.

4.5.1.2 Radiation Associated with Operating the Accelerator

Particle beams created by an accelerator produce (1) prompt radiation and (2) induced radioactivity in matter caused by prompt radiation. Prompt radiation is an intentional, routine consequence of accelerator operation. It is localized near the accelerator itself and can be shielded and controlled. Induced radioactivity (also called "activation") results when prompt radiation from an accelerator beam strikes matter (e.g., experimental targets, beam pipes, concrete shielding, soils, water, etc.). Radiation and the changes it causes in matter enable scientists to use accelerators to study the properties of materials or the structure of the nucleus of the atom.

Accelerator operators routinely engage in practices designed to minimize the extraneous production of radiation in undesirable locations. The quantity of induced radioactivity depends on several factors: (1) the type of accelerated particle (e.g., electron, ion, proton); (2) the beam energy; (3) the intensity (beam current); and, (4) the matter or object that it strikes

[22] NCRP 1987. The Exposure of the Population in the United States and Canada from Natural Background Radiation, NCRP 94.

(e.g., experimental targets or shielding). CEBAF and the FEL machine accelerate an electron particle beam, which induces radioactivity primarily in the beam-dissipating devices (beam dumps), although the amount of induced radioactivity from any of the Jefferson Lab machines is substantially less than that produced by other particle (e.g., proton) accelerators with comparable power. In addition, some activation occurs in the structural material enclosing the accelerators and their experimental halls or other target areas. Less than 0.1% of induced radioactivity may be produced outside the accelerator enclosure, primarily in adjacent groundwater and soils.

Accelerators and experiment facilities are typically sited either underground or at grade with thick concrete walls and substantial earth berms to provide cost-effective shielding. By design, radiation reacts with the shielding materials. Induced radioactivity in the shielding materials—whether steel, lead, concrete or earth—is related to both the composition of the material and the type of radiation interacting in the shield. In general, the induced radioactivity remains fixed-in-place in the shield material and cannot be separated from the material.

4.5.1.3 Radiation Protection at Jefferson Lab

DOE's Jefferson Lab is operated by JSA in accordance with applicable Federal laws and regulations, including those specified in a Radiation Protection Program Plan[23] approved by the DOE. All important aspects of radiation safety and protection, including DOE's ALARA goals, are regularly addressed in workshops and programmatic reviews. These reviews, which include peer reviews by other DOE laboratories in accordance with the DOE/JSA management and operations contract, will continue to take place in all areas with radiological significance within the Jefferson Lab complex, including CEBAF, the FEL and the RAD Storage Building.

4.5.1.4 Impacts to Radiation Workers

Most of the occupational radiation exposure at Jefferson Lab would continue to occur during maintenance activities on activated components. The level of induced radioactivity in the components is directly proportional to the amount of electron beam power lost in the components. If the CEBAF beam power operating limit is doubled, in theory, the amount of activation produced would be doubled, resulting in a theoretical doubling of radiation exposure; however, this is unlikely in that the same areas of high activation would exist (i.e., experiment hall targets and beam dumps). These areas are accessed infrequently for maintenance by a select few individuals, and sufficient planning and additional shielding would offset any substantial increase in radiation exposure. As a note, the collective dose for all individuals monitored onsite for a given calendar year (some 1,200 people on average) is typically approximately 1,000 mrem or a factor of five below the 10 CFR 835 limit for an individual.

The addition of Experimental Hall D is unlikely to produce substantial activation of materials, as it is designed to be run as a "low current" experimental hall, similar to experimental Hall B, which also has a history of minimal component activation. Running with photon beams results in a proportionately lower beam power loss and corresponding equipment activation.

The DOE regulatory limit for occupational exposure of radiation workers is 5,000 mrem/yr (5 rem/year). Jefferson Lab facilities were designed to maintain radiation worker exposure at less

[23] DOE 1995. Energy Research Approval of 10 CFR 835 Radiation Protection Program Plan for SURA.

than 250 mrem/yr, in accordance with DOE's ALARA objective. The 250 mrem/yr administrative limit applies to all Jefferson Lab radiation workers, whether they work at CEBAF, the FEL, or both. This administrative limit applies to the cumulative occupational exposure from all operations and maintenance activities involving the FEL and CEBAF. Present operations, which implement engineering and administrative controls such as shielding, the Personnel Safety System (which is composed of sensors, interlocks, and warning devices, designed to protect personnel from exposure to prompt radiation), and beam absorbers typically result in annual exposures much less than the 250 mrem/yr design goal. The administrative controls currently in use at Jefferson Lab will be supplemented with area monitors to ensure that robust exposure controls remain in place. Jefferson Lab has an effective program. Since 1996, less than 1% of those occupationally exposed to radiation had doses in excess of 100 mrem[24]. Lifetime radiation exposure metrics of Jefferson Lab as compared to those at other DOE facilities can be viewed on the Radiation Exposure Monitoring System webpage located at: http://www.eh.doe.gov/rems/

4.5.1.5 Impacts from the Upgrades and Commissioning, Operation & Maintenance

Operating the CEBAF accelerator at 2 MW, and depositing peak beam power in each of the HPBDs at 1 MW, will have no measurable increased effect on human health and safety compared to current CEBAF running conditions. Aside from the actions evaluated in this EA, there are no other sources of radiation either existing or planned for the CEBAF area. Thus, the operation of CEBAF and the FEL would not result in impacts to occupational and public health and safety.

An additional concern is the design basis for the high power beam dump assemblies in Halls A and C. The original HPBDs were designed for up to 1 MW at beam energies up to 10.0 GeV. At a higher energy, the electromagnetic cascade peaks deeper in the dump; this may adversely affect the thermal performance of the HPBD. This could potentially lead to failure of the dump and require repair, which would potentially result in radiation exposure of the workers doing the repair, but would not lead to contamination of the environment or radiation exposure of the public. There are four possible mitigation strategies, three of which are used in current operation. Following further analysis and review, a final mitigation strategy will be determined and implemented to ensure safe operation of the beam dumps.

The radiological shielding design and criteria used for new additions within the Jefferson Lab accelerator complex will continue to be based upon the same conservative models used in the original design basis for the CEBAF accelerator. As such, there will be negligible impact to the public and environment as a result of operating CEBAF, including the use of Hall D, at higher energies.

4.5.1.6 Effects of Prompt Radiation on the General Public

The annual DOE regulatory limit for prompt radiation exposure to members of the general public is 100 mrem (10 CFR 835). Normal practice for implementing this limit is to identify a critical population near a facility, then estimate and measure their resultant exposure to the radiation produced by the facility. DOE and Jefferson Lab, however, have adopted a "good neighbor"

[24] Jefferson Lab Annual Dose Summary Report for Calendar Year 2004, Radiological Exposure Information Reporting System (REIRS) Report, Newport News, Virginia, March 27.

policy, which requires that radiation exposure of the affected population near CEBAF be maintained much below any regulatory limit. Consequently, a design goal of 10% of the regulatory limit at the site boundary was established for the Jefferson Lab site and was incorporated in Jefferson Lab policy as stated in the Jefferson Lab Final Safety Assessment Document (FSAD)[25].

The chief source of radiation exposure for members of the general public is "skyshine" radiation. Skyshine is due to neutrons, escaping through the soil on each end station roof that serves as shielding, that scatter back to earth from the air. Neutron skyshine varies in a complex manner based on a number of variables. Approximately 50% of the "skyshine" is attributed to beam power lost during interactions in the target. The other 50% is due to beam power loss in the target exit pipe on the way to the dump. An increase in energy would cause the electron beam to be more forward peaked such that, although more beam power loss would occur at the target, this would be counteracted by more efficient beam transfer to the dump, and subsequently less beam power loss in the target exit pipe. The current system of planning for expected skyshine dose rates with a mixture of localized shielding, restricted beam currents, and target thicknesses will continue to be employed along with administrative limits. Boundary monitor locations will be evaluated to ensure effective placement for accurate measurement of the 10 mrem "good neighbor" policy. Each individual experimental run will continue to be evaluated and assigned a "radiation budget" by the RadCon prior to the commencement of the experiment. Localized shielding and/or experimental run time will be adjusted in order to ensure that the 10 mrem annual dose to a maximally exposed person offsite is not exceeded.

The addition of Experimental Hall D will have no effect on the boundary dose due to neutron skyshine. As a "low current" experimental Hall, similar to Experimental Hall B, beam power loss will be minimal. Proposed shielding for the experimental hall is more than adequate for preventing neutron skyshine of any consequence. Additionally, because of the placement of Hall D at the opposite end of the CEBAF accelerator path, in the event of neutron skyshine, it would not be additive; the boundary dose is all seen in the area closest to Experimental Halls A, B, and C.

Reasonable methods of calculation for a wide range of operating conditions have been used to estimate a dose to members of the general public at the site boundary and allow DOE to manage the annual radiation dose effectively. To date, more than ten years of experimental physics operations have been performed at CEBAF, and neutron radiation measurements at the site boundary (as shown in Table 7), when compared with estimates derived from calculation, indicate that estimates were reasonably accurate. These measurements substantiate the methodology used in the 1987 EA and confirm that, under present conditions, DOE is meeting its administrative control level policy of 10% of the regulatory limit for radiation exposure to the general public. The FEL machine does not contribute to radiation exposure to the general public. Experimental Hall D will not contribute to radiation exposure to the general public.

[25] SURA 2002. CEBAF Final Safety Assessment Document (FSAD), Rev. 5, Newport News, Virginia, November.

Table 7 - Annual Cumulative Radiation Boundary Dose (mrem/year)

Calendar Year	Neutron Dose	Gamma Dose	Total Dose
2004	2.82 ± 0.03	0.70 ± 0.02	3.52 ± 0.04
2003	0.87 ± 0.02	0.23 ± 0.02	1.10 ± 0.04
2002	2.36 ± 0.02	0.60 ± 0.02	2.96 ± 0.02
2001	4.55 ± 0.06	1.15 ± 0.02	5.70 ± 0.07
2000	3.05 ± 0.04	0.76 ± 0.02	3.81 ± 0.04
1999	4.27 ± 0.03	1.06 ± 0.02	5.33 ± 0.05
1998	0.81 ± 0.03	0.20 ± 0.02	1.01 ± 0.04

4.5.1.7 Effects of Airborne Radionuclides, Ozone, and Nitrogen Oxides

The public may be exposed to small quantities of radioactivity induced in air in the CEBAF enclosure as a result of nominal ventilation during routine operations. No airborne emissions are expected from the FEL that would contribute to the radiological dose to workers and the public.

The EPA dose limit to members of the general public from radioactive material in air is 10 mrem/yr. The EPA also requires that EPA-specified sampling protocols be put in place if the calculated dose to members of the general population exceeds 1% of this annual limit.

Hourly sampling for Jefferson Lab indicates that current CEBAF operations result in dose levels to the general public of less than 2.0×10^{-2} mrem/yr[26] as indicated in Table 8. This is 0.2 % of the annual limit of exposure, and 20% of the level where annual real-time monitoring would be required.

Table 8 - Annual Reported Dose to Maximally Exposed Individual Based on Hourly Air Sampling (mrem/year)

CY 2004	0.019
CY 2003	0.013
CY 2002	0.007
CY 2001	0.011

As is the case with most radiological parameters, an increase in beam power loss will lead to an increase in air activation. If the accelerator is to be run with a 2 MW envelope, air activation could increase by a factor of two. This increase will not exceed 1% of the EPA annual limit of 10 mrem/year dose to the maximally exposed individual.

[26] 2005 Annual NESHAP Report, Newport News, Virginia, June 20.

The activated air would also contain the pollutants ozone and oxides of nitrogen. Ozone concentrations have been calculated and measured at CEBAF. The concentration is highest in the experiment halls; peak levels have been measured at less than 10 parts per million (ppm). However, the time-weighted average concentration of ozone has been below the OSHA limit and the American Conference of Governmental Industrial Hygienists' threshold limit values (TLV) for occupational exposure (0.1 ppm). Because of normal chemical dissociation and ventilation loss when the beam is off, unsafe levels of ozone and oxides of nitrogen cannot be sustained. Adequate time is allocated between beam termination and radiological surveys to ensure that safe levels are obtained for worker protection.

The production of ozone, oxides of nitrogen, and radioactive gases have been shown to be directly proportional to the amount of beam power loss. With an increase in beam power envelope to 2 MW, and assuming target materials and thicknesses similar to those currently used in CEBAF, beam power loss is likely to increase on the order of a factor of two, so nitrogen oxides, ozone, and radioactive gases should increase proportionally.

4.5.2 Final Usage EH&S Impact

All projects and activities identified under this EA will be used or operate under the present guidance of the EH&S Manual and consequently will not introduce any new EH&S impacts not already addressed by existing policies and procedures.

4.5.3 Construction Hazards

Normal construction-related hazards will be present during the building of each of the structures identified in this EA. These common construction hazards include: transporting materials and equipment to and around each jobsite; noise in the immediate work area; electrical safety; material handling; trenching and excavation; and, working on elevated areas. Each of these hazards will be mitigated using a combination of OSHA Construction Standards; best industry practices including appropriate personal protective equipment use; Jefferson Lab's training and procedures; and, other special practices and procedures to be identified in the construction subcontractor's site-specific Safety Plan. The subcontractor's Safety Plan will include appropriate activity hazard analysis and mitigation and must be approved by Jefferson Lab prior to the start of on-site construction activity. Jefferson Lab provides an inspection program and incorporates financial safety incentives into the subcontract agreements to further encourage safe work practices.

4.5.4 Non-Radiological Hazards

Non-radiological hazards associated with the proposed action include cryogenics, electrical hazards, static magnetic fields, chemical hazards, and non-ionizing radiation hazards (lasers), oil spills, nature/environment, and other general industrial hazards which could injure and in extreme cases, could potentially be fatal to occupational workers (discussed below). All such hazards were examined in the current draft of the FSAD[25] and were examined earlier in the initial Work Smart Standards (WSS) effort at Jefferson Lab. (Refer to the Jefferson Lab EH&S Manual for the list of WSS hazards.) The WSS Set lists the appropriate regulatory standards that are needed to control the hazards which are implemented through the Jefferson Lab EH&S Manual.

The safety analysis methodology used in the above referenced FSAD is appropriate and reasonable for Jefferson Lab's Low Hazard classification. Nineteen non-radiation hazards in eight different categories were analyzed in the FSAD.

Cryogenics: The cryogenic hazards at Jefferson Lab in order of decreasing risk are: cold burns, asphyxiation, explosion-pressure, and explosion-chemical. The site locations where cryogenic hazards exist are: refrigeration plants (CHL, ESR, and CTF), the transfer line distribution system, RF cavity systems (injector, north and south linacs, FEL vault, and certain areas of the Test Lab), and the Halls (cryogenic magnets and targets).

It is Jefferson Lab policy to follow national cryogenic safety standards. In addition, Jefferson Lab has implemented a site specific cryogenic safety program summarized in the Jefferson Lab EH&S Manual.

Electrical: Electrical power is used in a variety of ways at Jefferson Lab ranging from the standard industrial AC and DC power to RF power. Most of the electrical power is used to accelerate, steer and control the electron beam. The two main electrical hazards at Jefferson Lab are: standard industrial DC and 60-cycle AC power, and RF, or microwave power. The standard industrial hazards are throughout the site with the DC power primarily associated with the beam transport magnets and experimental area equipment. These hazards could result in death due to electrocution caused by AC or DC power or in a lesser accident that could result in injury but no deaths.

Electric shock hazards are well understood and are readily prevented by standard industry practices including national electrical safety standards, codes and procedures that are implemented. Administrative procedures that minimize the potential for such accidents are specified in the Jefferson Lab EH&S Manual.

Static Magnetic Fields: Magnetic fields are used at Jefferson Lab to steer and control the electron beam and in the experimental halls as spectrometers and critical components of polarized targets. Though most static magnetic fields associated with most magnets are confined to their interiors and present no hazard, the experimental halls have specialized magnets with high static magnetic fields.

To protect people in the area from uncontrolled projectiles, national standards, codes, and local site-specific procedures which are outlined in the EH&S Manual are practiced. In addition, hazards associated with static magnetic fields are addressed, when appropriate, in the Experiment Safety Assessment Document (ESAD) required of every experiment.

Chemical: The most hazardous chemicals at Jefferson Lab are those used for surface preparation of the niobium cavities in the Accelerator. These chemicals are used primarily in controlled areas in the Test Lab and in the adjacent Acid Transfer Building. There are two commonly used mixtures: Buffered Chemical Polish (BCP) and Electropolish Acid (EP).

The principal chemical hazard at Jefferson Lab is BCP, which is a mixture of nitric, phosphoric, and hydrofluoric acids (the most hazardous of the chemicals on-site). A spill could lead to burns from splashed liquid and lung damage from acid mists to those in the immediate vicinity. Procedures to minimize such accidents are provided in the Jefferson Lab EH&S Manual and in specially developed work control documents. Additional chemical hazards that may arise from the operation of CEBAF and FEL will be governed by administrative procedures specified in the EH&S Manual.

Jefferson Lab has implemented several mitigative factors to reduce the probability of a chemical accident and/or ameliorate the consequence of an accident, including those involved with hazardous wastes, should one occur. It is Lab policy to follow national chemical safety standards, codes, and procedures. Jefferson Lab also has a site-specific chemical safety program included in the EH&S Manual and specialized training.

Lasers: There are two significant non-ionizing radiation applications at Jefferson Lab. The first is the radiofrequency 1497 MHz (megahertz) used to accelerate the electron beam in superconducting cavities. High power RF energy is transported via waveguides, shielded metal conduits which essentially confine all fields to the inside of the waveguide, therefore leakage is not expected. Leaks may occur at flanges although highly unlikely. To mitigate any such leak, flanges are gasketed and the waveguide is pressurized to about 1 psi (pound per square inch). Pressure loss is monitored and an associated leak detection interlock protects staff from overexposure to RF.

The second non-ionizing radiation application involves the use of laser beams and laser systems. There are two types of laser applications: production applications and R&D applications. Production applications use lasers to generate the electrons used in the accelerators and are also used to perform electron beam diagnostics. R&D applications are more varied and range from optimization efforts to support production use of lasers to pure R&D performed by visiting users at the FEL. Hazards associated with the use of lasers are direct exposure to the laser light and exposure to specular or diffuse reflections. The target organs are the eye and the skin. Procedures for laser safety require that each potential experimenter be formally trained in pertinent local safety regulations and specific safety procedures for their test area. Safety operating procedures are developed, documented, and approved by a qualified Jefferson Lab Laser Safety Officer and the Line Management responsible for the laser activity. As is standard practice for operations at TJNAF, applicable standards for all class 3b and class 4 lasers will be followed. Appropriate ANSI and FAA codes and aerospace requirements will be applied for the proposed activity for the outdoor propagation of FEL light. Additionally, site specific policy and controls are documented in the Jefferson Lab EH&S Manual. As well, Jefferson Lab has a designated Laser Safety Officer.

Mitigating factors include the use of engineering and administrative controls as well as personal protective equipment. It is Jefferson Lab policy to follow national standards, codes, and procedures as outlined in the EH&S Manual *Appendix 2410-T2* (reference WSS issue 097) for laser safety. In addition, Jefferson Lab has implemented a site

specific laser safety program detailed in the Jefferson Lab EH&S Manual Chapter 6410 and accompanying Appendices.

Oil Spills: Oil and related petroleum substances exist at Jefferson Lab as new products, in-process oil, diesel fuel, used oil, and oil-contaminated materials. Jefferson Lab is responsible for about 40,000 gallons of oil, contained primarily in transformers and operating mechanical equipment. Within the Jefferson Lab site, Dominion Virginia Power, which has its own SPCC Plan, is responsible for about an additional 6,000 gallons that is contained in its transformers.

National standards, codes, and site specific procedures, including those outlined in the EH&S Manual for preventing spills from occurring, and control and response in the event of a release, are practiced. Along with EH&S Manual procedures, the Lab program is presented in the SPCC Plan and each division has its own work control documents that address its specialized equipment.

Nature/Environment: The geographic location of Jefferson Lab determines its vulnerability to several naturally occurring hazards. The naturally occurring hazards, in order of severity, are: hurricane, flood, tornado, lightning, and earthquake.

Hurricanes have resulted in little property damage on the Peninsula except along the coast. However, Hurricane Isabel in September 2003 disrupted accelerator operations for several days. Tornadoes, though not unknown, are infrequent on the Peninsula, at least compared with regions of high activity such as the southern Great Plains. Thunderstorms are rather frequent in the Tidewater area, appearing on average 37 times each year with the accompanying lightning hazard. Lightning is hazardous both to personnel and to equipment (all major structures are equipped with lightning arrestor systems). The extensive study of seismic activity conducted for the Surry nuclear power plant, only 10.5 miles from Jefferson Lab, concluded that no earthquake of intensity VI or greater on the Modified Mercalli scale is likely.

Lab policy and procedures to deal with naturally occurring hazards are set out in the Jefferson Lab Emergency Management Plan. Facilities Management maintains site storm water channels and provides expertise to address local flooding that can occur as a result of natural hazards.

General Industrial Hazards: Normal industrial hazards that are commonly found in ordinary industry are not specifically itemized here. Jefferson Lab has, however, adopted special precautions for the movement of spectrometer magnets and noise. A third hazard, fire, is discussed briefly although it is commonly found in ordinary industry and is more fully analyzed and discussed elsewhere.

Spectrometer Magnets: Large items of equipment are routinely moved around the site and within the accelerator buildings. This is particularly evident during phases of construction. All the appropriate codes of practice are followed to ensure that such operations are conducted safely. Jefferson Lab policy and

procedures on the use of the spectrometers is found in EH&S Manual Chapter 3120, The CEBAF Experimental Review Process.

Noise: Although the refrigeration system is the major source of noise at Jefferson Lab, other systems can generate substantial noise in transient conditions. The highest noise level is in the main compressor building, followed by the cold box area of the refrigerator building. Other high noise areas include the mechanical rooms in Building 28, the building known as the VARC, and in Building 58, the Test Lab. These areas are occupied only during hardware maintenance and repair periods.

Noise exposure for SURA employees is minimized to stay within the American Conference of Government Industrial Hygienists TLVs for Occupational Exposure to Noise, 85 dBA, averaged over an eight hour work shift. Whenever practical, noise levels are reduced by engineering at the source, shielding, and ambient absorption. To minimize exposure to noise levels, hearing protection is required in areas where noise levels meet or exceed 85 dBA. A further mitigation activity is the Jefferson Lab hearing conservation program administered by Occupational Medicine and the Industrial Hygiene staff.

Fire: The most likely causes of fire at Jefferson Lab are first electrical faults and second improper welding, cutting, and grinding practices. The combustible material most likely in the accelerator tunnel, service buildings, and halls is cable insulation. The consequences of an accident involving fire would be localized but may include death, severe injury or severe occupational illness to personnel, or major damage to the facility/operation.

Jefferson Lab has several major fire-hazard mitigation efforts. They include: 1) a fire protection plan which requires all buildings (except Building 13 and individual trailers), tunnel and halls to be equipped with fire detection/alarm systems and sprinkler systems; 2) inspection, testing, and maintenance of these systems in accordance with applicable codes and standards; 3) incorporation of fire emergency procedures into the Emergency Management Plan; 4) a training program that includes frequent on-site visits by local fire and rescue teams, periodic training drills, fire watch training, and voluntary staff training in the use of fire extinguishers; and, 5) requiring and monitoring the use of fire hazard permits or Operational Safety Procedures (OSPs) for welding and similar activities.

4.6 CUMULATIVE IMPACTS

Cumulative environment, health, and safety impacts are those which result from the incremental contribution from each effect discussed above along with impacts expected from other past, ongoing, or planned actions within the same geographic area.

Both on and offsite major construction activities will have temporary and long term site related impacts. On-site construction actions would be managed to keep impacts to a minimum. Even

though DOE has no control over offsite activities, the mitigation of the on-site impacts will be such to have little to no impact offsite. It is assumed that both short and long term impacts from offsite construction activities, including any on the adjacent SURA property, would be limited to effects outside of the DOE property lines. In actuality, as wooded areas belonging to the City of Newport News and other adjacent property owners are eliminated, their current wildlife seek refuge wherever possible, many towards the partially wooded DOE and SURA land.

As for environment, health, and safety related operational impacts, facility designs will manage the impacts to the maximum extent possible and then administrative controls will be utilized. It is anticipated that any development on the adjacent SURA and City properties would also be managed to keep impacts to a minimum and to result in no impact to the DOE site. The long-term effect from the additional impervious cover on-site has been analyzed with consideration of Jefferson Lab's master plan. BMPs have been identified to address long-term on-site effects and to not increase existing impacts on offsite properties. DOE has and will continue to work with the City of Newport News and SURA on storm water management issues.

The minimal impacts related to CEBAF and FEL operations will be long term, but will be managed to keep them to a minimum as noted in this EA. The radiological impact of the action proposed in this EA will be offset by factors such as radioactive decay and dilution. Radioactivity levels will remain well below permit limits and, therefore, any changes will be inconsequential. There will be cumulative impacts involving radioactivity from the combination of operating the existing CEBAF and FEL accelerators. This is true even though there are no changes in CEBAF or FEL operations proposed under this action. The only other known source of radioactivity in the general site area is in the adjacent ARC Building. CEBAF and the FEL will be operated within their proposed or specified operating limits and within identified site limits to minimize cumulative impacts to the environment, occupational health factors, and public health and safety concerns.

Thus, there would be cumulative impacts when taking into account the construction, operation, and use of the new buildings and with the power upgrades to the CEBAF and the FEL when combined with the other impacts from beyond the site boundaries, though none of these actions would have major impacts to occupational and public health and safety.

4.7 IMPACTS OF NO ACTION

If No Action were taken on this proposal, DOE would continue operating the Jefferson Lab facility in a manner that is not optimal to support staff and researchers. This applies to all of the identified construction projects, with each one serving at least one important purpose, and for the upgrades to the CEBAF and FEL, and the commissioning and operation of Experimental Hall D.

With No Action, the disturbance from construction activities would be avoided, but the research benefits and the long term use of the Jefferson Lab facility will diminish.

With No Action, the minimal environmental effects due to CEBAF and FEL operation would not occur, but the research planned for the proposed Hall D, will also not take place. With No Action, we would miss out on numerous research opportunities.

- CEBAF – If No Action is taken on this proposal, DOE would continue operating CEBAF within a beam energy range up to 8.0 GeV. With No Action, the environmental effects of CEBAF operation would continue to be minimal, as they have been over the past year of operation. Maintaining the status quo and not performing the CEBAF upgrade means that the U.S. Nuclear Physics program will lose its world leadership in the study of hadronic matter.

- Halls A, B, C, & D – The possibilities for researchers to explore this new energy range would not be available at the three existing halls. If the Hall D complex was not built, one of the two major physics programs related to the Jefferson Lab upgrade, identified by the recent DOE Science Review in April 2005 as having discovery potential, would be lost. This loss would weaken the U.S. Nuclear Physics program.

- FEL Upgrade – If No Action is taken on this proposal, the FEL could continue in a limited applications mode but would likely lose any support from the DOD and thus weaken an important research effort for U.S. defense. It would remove the only operating source for developmental research of tunable high power photon defensive devices. Furthermore, the future beneficial research in using tunable photons would be severely curtailed and the US would lose its world leadership in cutting edge research.

- Associated Buildings – The proposed buildings and extensions would support both existing and the upgraded accelerator operations. The impact of No Action for upgraded operations is addressed above. The TSB2 is to support current operations. Current staff is working out of aging trailers and out of accelerator service buildings not designed for occupants. As well, many of the involved groups are not collocated or are not located near their technical work area. For existing operations, No Action will continue use of sub-standard work spaces and operational inefficiencies.

- Infrastructure Improvements – With No Action on this proposal, other means for addressing current and future storm water retention may need to be researched. As well, non-optimal traffic flow and parking availability will remain as is. Also with No Action, the utility improvements for the Accelerator Site that would also enhance current operations would not occur.

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NOTE: All references are available for review at the DOE Site Office at Jefferson Lab in Newport News, Virginia.

6.0 LIST OF PREPARERS

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Appendix A – Abbreviations and Acronyms

	AC	Alternating Current
	ALARA	As Low As Reasonably Achievable
	amp	Ampere
	AQCR	(Hampton Roads Intrastate) Air Quality Control Region
	ARC	Applied Research Center (City of Newport News)
	BCP	Buffered Chemical Polish
	BMP	Best Management Practice
	CBPA	Chesapeake Bay Preservation Area
	CBPADMR	Chesapeake Bay Preservation Area Designation and Management Regulations
	CEBAF	Continuous Electron Beam Accelerator Facility
	CEQ	Council on Environmental Quality
	CFR	Code of Federal Regulations
	cfs	Cubic Feet Per Second
	CHL	Central Helium Liquefier
	Ci	Curie
	cm	Centimeter
	CW	Continuous Wave
	CZMA	Coastal Zone Management Act
	dB / dBA	Decibels
	DC	Direct Current
	DCR	Department of Conservation and Recreation
	DEQ	(Commonwealth of Virginia) Department of Environmental Quality
	DOE	(United States) Department of Energy
	EA	Environmental Assessment
	EAD	Environmental Assessment Determination
	EHM	Environmentally Harmful Material
	EH&S	Environment, Health, and Safety
	EIS	Environmental Impact Statement
	E&SC	Erosion and Sediment Control
	EMS	Environmental Management System
	EP	Electropolish Acid
	EPA	Environmental Protection Agency
	EPP	Environmentally Preferable Purchasing
	ESA	Environmental Site Assessment
	ESAD	Experiment Safety Assessment Document
	ESR	End Station Refrigerator
	E2	Energy Efficiency
	FDS	Floor Drain Sump
	FEL	Free-Electron Laser
	FONSI	Finding of No Significant Impact
	FSAD	Final Safety Assessment Document
	ft.	feet
	FY	Fiscal Year (1 October to 30 September)
	GeV	Giga (billion) electron-volt
	Helios	High-Energy Lithography Source

	HPBD	High Power Beam Dump
	HRSD	Hampton Roads Sanitation District
	ICW	Industrial Cooling Water
	in	Inch
	IR	infrared
	ISO	International Organization for Standardization
	JSA	Jefferson Science Associates, LLC
	Jefferson Lab	Thomas Jefferson National Accelerator Facility
	km	Kilometer
	kW	Kilowatt
	L	Liter
	LCW	Low Conductivity Water
	linac	Linear Accelerator
	LPC	Laser Processing Consortium
	mA	milliampere
	MDC	Minimum Detectable Concentration
	MeV	Million electron volts
	MHz	Megahertz
	ml	Milliliter
	mrem	Millirem
	MSL	Mean Sea Level
	MS4	Small Municipal Separate Storm Sewer System
	MVA	Megavolt Amp
	MW	Megawatt
	NAAQS	National Ambient Air Quality Standards
	NCRP	National Commission on Radiation Protection and Measurement
	NEPA	National Environmental Policy Act
	NESHAPs	National Emission Standards for Hazardous Air Pollutants
	NSAC	Nuclear Science Advisory Committee
	OSHA	Occupational Safety and Health Administration
	pCi	Picocuries
	pH	
	ppm	parts per million
	psi	pound per square inch
	P2	Pollution Prevention
	RAD	Low-Level Radioactive Waste
	RadCon	Radiation Control Department
	RF	Radio frequency
	RMA	Resource Management Area
	RPA	Resource Protection Area
	R&D	Research and Design
	SCS	United States Soil Conservation Service (now Natural Resources Conservation Service)
	SPCC	Spill Prevention, Control, and Countermeasure (Plan)
	SF	Square Feet
	SRF	Superconducting Radiofrequency

	SURA	Southeastern Universities Research Association, Inc.
	SWP3	Storm water Pollution Prevention (Plan)
	TSB2	Technical Support Building #2
	TJNAF	Thomas Jefferson National Accelerator Facility (Jefferson Lab or JLab)
	TLV	Threshold Limit Value
	UV	Ultraviolet
	VADGIF	Commonwealth of Virginia Department of Game and Inland Fisheries
	VADHR	Commonwealth of Virginia Department of Historic Resources
	VADCRDNH	Commonwealth of Virginia Department of Conservation and Recreation, Division of Natural Heritage
	VCP	Virginia's Coastal Resources Management Program
	VPA	Virginia Pollution Abatement Permit
	VOC	Volatile Organic Compound
	VPDES	Commonwealth of Virginia Pollutant Discharge Elimination System
	VRP	Voluntary Remediation Program
	yr	Year

Appendix B - Consultation and Correspondence with Stakeholders

Additional consultation is ongoing and correspondence from each stakeholder will be attached to the final document.

COMMONWEALTH of VIRGINIA

James S. Gilmore, III
Governor

John Paul Woodley, Jr.
Secretary of Natural Resources

Department of Historic Resources
2801 Kensington Avenue, Richmond, Virginia 23221

Kathleen S. Kilpatrick
Director

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TDD: (804) 367-2386
www.dhr.state.va.us

September 6, 2001

Ms. Barbara Morgan

DOE NEPA Document Manager
Department of Energy
Thomas Jefferson National
Accelerator Facility Site Office
12000 Jefferson Avenue
Newport News, Virginia 23606

Re: Improvements to Thomas Jefferson National Accelerator Facility
Newport News, Virginia
DHR File Number 1992-2142

Dear Ms. Morgan:

Thank you for providing us with the additional information requested. Based on that information, the DHR concurs with the DOE that the proposed improvements to the Thomas Jefferson National Accelerator Facility will not effect historic properties.

Thank you again for consulting with us. If I can be of any further assistance, do not hesitate to contact me at (804) 367-2323 ext. 140 or lrichards@dhr.state.va.us.

Sincerely,

Lily A. Richards
Archaeologist and Historian, Division of Resource Services and Review

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City of Newport News
Department of Planning and Development
2400 Washington Avenue • Newport News, VA 23607
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Graphic Services (757) 926-8881 • Harbor Master (757) 247-8437
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DOE/TJNAF
01 APR 31 PM 3:31

April 25, 2001

Department of Energy
Garry Conley
12000 Jefferson Avenue
Newport News, VA 23606

Dear Mr. Conley:

The property located at 12000 Jefferson Avenue contain neither Chesapeake Bay Resource Protection nor Resource Management features. It, therefore, does not fall under the purview of the Chesapeake Bay Protection Act.

Sincerely,

David Watson
Environmental Planner